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January 13, 2012 Reference No. 038443-73

Ms. Karen Cibulskis
Remedial Project Manager
United States Environmental Protection Agency
Region V
77 West Jackson Boulevard
Mail Code SR-6J
Chicago, IL 60604

Dear Ms. Cibulskis:

Re: Shallow Groundwater Investigation Work Plan (Work Plan)
South Dayton Dump and Landfill Site Moraine, Ohio (Site)

This Work Plan presents the proposed approach for additional investigation of shallow groundwater conditions at the Site boundary between VAS-09 and VAS-22 and in the vicinity of MW-210 (Shallow Groundwater Investigation). Conestoga-Rovers & Associates (CRA) has prepared this Work Plan on behalf of the Respondents to the Administrative Settlement Agreement and Order on Consent (ASAOC) for Remedial Investigation/Feasibility Study (RI/FS) of the Site, Docket No. V-W-06-C-852 (Respondents) in accordance with the Dispute Resolution Agreement signed by the Respondents and USEPA on December 10, 2010.

This Work Plan also presents a discussion of the suspected underground storage tank (UST) at the Command Roofing property located on Parcel 5174, at 2045 Dryden Road in Moraine, Ohio (hereafter referred to as the “Property” or “Facility”).

The Respondents include Hobart Corporation (Hobart), Kelsey Hayes Company (Kelsey-Hayes), and NCR Corporation (NCR). These three Respondents are and have been performing the Work required by the ASAOC under the direction and oversight of the USEPA.

The work proposed in this Work Plan will be performed in accordance with the United States Environmental Protection Agency- (USEPA-) approved Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and Site-Specific Health and Safety Plan (HASP), and associated addenda that are submitted as attachments to this Work Plan.

This Work Plan is presented in the following titled sections:

1.0 Suspected UST at Command Roofing (Parcel 5174)
2.0 Shallow Groundwater Investigation

1.0 SUSPECTED UST AT COMMAND ROOFING (PARCEL 5174)

1.1 BACKGROUND

On June 22, 2011, CRA completed a building physical survey of the Command Roofing Property on Parcel 5174 Building 1 at 2045 Dryden Road. Representatives of CH2M Hill, USEPA's oversight consultant, and the Ohio Environmental Protection Agency (Ohio EPA) were present during this inspection. During this investigation, CRA observed structures consistent with an above ground vent pipe and in-ground fill port. The condition and contents of the suspected UST are unknown, as CRA did not complete any further inspections of the suspected UST during the building physical survey. A previous tenant of the Command Roofing Property was Buckeye Boiler, a pressure vessel manufacturer. The dates of occupancy of Buckeye Boiler and the nature of other historical tenants are unknown.

On December 8, 2011, CRA contracted Blood Hound Inc. (Blood Hound) to locate utilities at the Command Roofing Property for the Vapor Intrusion Investigation. Blood Hound used a small cart-mounted ground-penetrating radar unit to identify subsurface utilities within and around the building. Blood Hound also screened the area adjacent to the suspected fill port and vent pipe. Blood Hound detected the presence of a subsurface structure, consistent with the size and shape of an UST. The location of the suspected UST was north of the Command Roofing Property building, immediately east of the truck ramp. The size of the UST was estimated to be 9 feet (ft) by 15 ft, oriented in an east - west direction, with an approximate capacity in the range of 2,000 to 2,500 gallons. Figure 1 presents the approximate location of the suspected UST on the Command Roofing Property.

Laura Marshall of the Ohio EPA contacted Bryan Duzack of the Bureau of Underground Storage Tank Regulations (BUSTR) to request records of the tank. BUSTR did not have any records of USTs for the Command Roofing Property address. Bryan Duzack stated BUSTR does not have jurisdiction over tanks used to store fuel oil for consumptive purposes.

No soil, groundwater or soil vapor data are available for the immediate area of the suspected UST. The closest investigative location is soil gas probe GP13-09 at the northwest corner of the building on the Command Roofing Property (approximately 160 ft to the west of the location of the suspected UST. In 2009, CRA collected soil vapor samples from GP13-09 and analyzed the samples for Toxic Organic Compendium Method 15 (TO-15) list of volatile organic compounds

(VOCs). The soil vapor samples contained 1,1-dichloroethane at a concentration of 2,900 micrograms per cubic meter (µg/m^3), and vinyl chloride at a concentration of 6,800 µg/m^3. CRA measured sub-surface explosive gas concentrations in the range of 3.3 to 3.7 percent as methane in the soil vapor present in GP13-09.

In an email dated December 14, 2011, USEPA requested that the Respondents include investigation of the suspected UST in the Work Plan. The Respondents believe that further investigation of the UST is the responsibility of the property owner and/or operator and respectfully request that USEPA approach the owner/operator regarding investigation of the suspected UST.

2.0 SHALLOW GROUNDWATER INVESTIGATION

2.1 BACKGROUND

Under the December 10, 2010 Dispute Resolution Agreement, the Respondents agreed to investigate the shallow groundwater along the Site boundary between VAS-09 and VAS-22 and in the vicinity of monitoring well MW-210. The results of this investigation will be used to identify potential risks to off-Site receptors from VOCs and naphthalene migrating off-Site in groundwater and into buildings via the vapor intrusion pathway.

Specifically, the Dispute Resolution Agreement requires the Respondents to:

> *submit a work plan (Shallow Groundwater Work Plan) including FSP and QAPP Addenda, for additional characterization of the top five feet of shallow groundwater in the vicinity of Monitoring Well 210 (MW-210) at the locations in the Respondents' draft MW-210 Shallow Groundwater Investigation Letter Work Plan, dated March 16, 2010, and at locations no greater than 100 feet apart at the Site boundary starting: 1. adjacent to Dryden Road east of VAS-09; 2. continuing south to the Site boundary at the intersection of Dryden Road and East River Road; 3. continuing west along the south side of the access road to Lot 4610, with a sampling point at the northeast corner of Lot 4610; 4. continuing south along the east boundary of Lot 4610 to Lot 3254 (skipping the Site boundary around Lot 3252); and 5. continuing southwest along the East River Road boundary of the Site to a location east of VAS-22 (Shallow Groundwater Investigation Letter Work Plan). See highlighted area on [Figures 2 and 3], attached, for an illustration of the sampling area. The data quality objectives for the groundwater samples will include, but are not limited to, detecting VOCs and naphthalene in shallow groundwater at the Site boundary that pose more than a 1×10^{-6} cancer risk or a hazard index greater than 1.0 through the vapor intrusion pathway to current or potential future receptors. The samples may be collected using direct push technology, and will be*

> *collected using low-flow sampling and groundwater stabilization procedures consistent with those developed for the vertical aquifer sampling previously conducted during RI/FS Work at the Site provided the low-flow sampling and groundwater stabilization procedures meet the data quality objectives required for the VI Study. The sampling intake will be set approximately 2.5 feet below the water table. This Shallow Groundwater Work Plan for additional characterization of groundwater shall be submitted by December 17, 2010.*

The Respondents prepared this Letter Work Plan based on requirements of the Dispute Resolution Agreement, previous investigation results and discussions between the Respondents and USEPA. The Respondents submitted a draft Letter Work Plan to USEPA on December 17, 2010. USEPA provided comments on the draft Letter Work Plan as an attachment to an email dated July 27, 2011. This revised Letter Work Plan incorporates USEPA's comments.

Trichloroethene (TCE) has been consistently detected in shallow groundwater samples collected from MW-210. MW-210 is screened between 26 and 36 ft bgs and the well screen is 5 ft below the water table. The TCE concentrations in groundwater samples collected from MW-210 between 1999 and 2009 ranged from 30 to 260 µg/L, which were greater than the USEPA RSL MCL of 5 µg/L.

2.2 SCOPE OF THE SHALLOW GROUNDWATER INVESTIGATION

The general objective of the Shallow Groundwater Investigation is to identify whether contaminants present in the upper 5 ft of shallow groundwater at the Site boundary between VAS-09 and VAS-22, and in the vicinity of MW-210 may be migrating off Site at concentrations that pose more than a 1×10^{-6} excess cancer risk or a hazard index (HI) greater than 1 to current or potential future receptors via the vapor intrusion pathway. An additional objective of the Shallow Groundwater Investigation is to evaluate possible shallow upgradient sources of the TCE contamination identified in groundwater samples collected from MW-210. These objectives will be accomplished by collecting and analyzing groundwater samples from new borings completed in select locations between VAS-09 and VAS-22, and surrounding MW-210 as shown on Figures 2, and 3, respectively.

The Shallow Groundwater Investigation will also include the collection of a groundwater sample from the water supply well located 500 ft downgradient of MW-210. The well is located at 2447 East River Road. Based on the Ohio Department of Natural Resources Well Log and Drilling Report for water supply well (log number 966148), on February 7, 2005, a well test was completed on the well at a pumping rate of 650 gallons per minute for one hour. Attachment C presents the associated well schedule.

Shallow Groundwater Investigation Data Quality Objectives

There are seven steps in the Data Quality Objective (DQO) process[1]. A discussion of the DQO steps for the Shallow Groundwater Investigation is presented below.

Step 1: State the Problem – VOCs and naphthalene are present in shallow groundwater beneath the Site. A data gap exists with respect to whether VOCs and naphthalene contaminants in OU1 shallow groundwater between VAS-09 and VAS-22, and in the vicinity of MW-210, are migrating off-Site in this area at concentrations that may pose an unacceptable risk to current or potential future receptors via the vapor intrusion pathway. A data gap exists with respect to the source of TCE in OU1 shallow groundwater in the vicinity of MW-210.

Step 2: Identify the goals of the study – Complete a screening level investigation to determine whether contaminants identified in the specified areas are migrating off Site via shallow groundwater at concentrations that may pose an unacceptable risk to current or potential receptors via the vapor intrusion pathway. Identify areas where off-Site migration is occurring and further investigation, e.g., installation of additional boreholes, permanent monitoring wells or soil gas probes, or remediation, is required.

An additional goal of the MW-210 investigation is to evaluate possible shallow upgradient sources of the TCE contamination present in groundwater samples collected from MW-210.

Step 3: Identify information inputs – Complete groundwater investigations using direct push technology and low flow groundwater sampling to determine VOC and naphthalene concentrations in shallow groundwater at discrete locations along the Site boundary and immediately upgradient of MW-210.

Step 4: Identify the boundaries of the study – The Study Area for the shallow groundwater investigation is detailed below, and presented on Figures 2 and 3.

- In the vicinity of monitoring well MW-210
- At locations no greater than 100 ft apart at the Site boundary starting
    - Adjacent to Dryden Road, east of VAS-09
    - Continuing south to the Site boundary at the intersection of Dryden Road and East River Road

1 As detailed in the USEPA document *Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4, February 2006.*

- Continuing west along the south side of the access road to Lot 4610, with a sampling point at the northeast corner of Lot 4610
- Continuing south along the east boundary of Lot 4610 to Lot 3254 (skipping the Site boundary around Lot 3252)
- Continuing southwest along the East River Road boundary of the Site to a location east of VAS-22

Step 5: Develop the analytic approach – Groundwater samples will be collected using low flow sampling techniques from the top 5 ft of shallow groundwater in each borehole, following purging and stabilization. The sample intake will be set at 2.5 ft below the water table. Samples will be collected using the sampling methodologies outlined in the FSP and relevant addenda. Groundwater samples will be submitted for analysis of VOCs and naphthalene using the analytical methodologies outlined in the QAPP.

Step 6: Specify Performance or Acceptance Criteria – Performance criteria consist of identifying VOCs and naphthalene that pose more than a 1×10^{-6} cancer risk or a HI greater than 1 to current or potential future receptors via the vapor intrusion pathway. The maximum width of a groundwater plume containing VOCs at concentrations greater than MCLs at the Site boundary that may escape detection during the investigation is 100 ft over most of the Site boundary between VAS-09 and VAS-22 and is 20 ft in the vicinity of MW-210 (see Figures 2 and 3).

Upgradient of MW-210, the performance criteria are simply to identify any zones of VOC contamination that might be contributing to the VOC contamination present in samples of shallow groundwater collected from MW-210.

Step 7: Develop the plan for obtaining data – See Sections 2.2.1 to 2.4 below, for detailed procedures proposed in order to obtain the required data.

Vapor Intrusion (VI) is the migration of volatile chemicals from the subsurface into overlying buildings. VI is a potential concern at any building, existing or planned, located near soil or groundwater contaminated with toxic chemicals that can volatilize. USEPA's 2002 draft guidance document, entitled "OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (OSWER Draft Guidance), defines "near" as:

> *volatile or toxic compounds within 100 ft (laterally or vertically) of buildings, unless there is a conduit that intersects the migration route that would allow soil gas to migrate further than 100 ft.*

> The OSWER Draft Guidance defines a conduit as: "*any passageway that could facilitate flow of soil gas, including porous layers such as sand or gravel, buried utility lines, and animal burrows.*"

At the commencement of the Shallow Groundwater Investigation, CRA will visually assess the Site boundary within the Study Area for evidence of conduits that might facilitate the flow of soil gas and will install and sample the groundwater from boreholes located immediately adjacent to any such conduit, in addition to the boreholes discussed above and shown on Figures 2 and 3.

2.2.1 CHLORINATED SOLVENT DELINEATION FOR SHALLOW GROUNDWATER IN THE AREA OF MW-210

The greatest TCE concentrations in groundwater samples collected from any permanent monitoring well are in the samples collected from MW-210. Groundwater impacts at VAS-21 and monitoring wells MW-210, MW-210A, and MW-210B are well defined vertically to 200 ft below ground surface[2]. The Respondents propose to complete additional investigation in the vicinity of MW-210 to determine the concentrations of VOCs and naphthalene in shallow groundwater to determine the potential for unacceptable risks to receptors via the VI pathway. Additionally, the Respondents proposed to determine TCE concentrations in shallow groundwater in the vicinity of MW-210 to evaluate possible sources of the shallow TCE contamination identified in MW-210.

CRA will advance seven boreholes on Site to the south and east of the MW-210 monitoring well nest at an initial distance interval of 20 ft along the southern fence line. To the north of the MW-210 monitoring well nest, CRA will advance four boreholes at an initial distance interval of 40 ft. Boreholes will be advanced to the top 5 ft of shallow groundwater, to a maximum depth of 40 ft (i.e., to the top of the till layer[3]). Figure 3 presents the approximate locations of the proposed boreholes around MW-210.

2.2.2 SHALLOW BOUNDARY GROUNDWATER INVESTIGATION

The VOC concentrations in shallow groundwater in the vicinity of VAS-09 may be linked to the VOC concentrations in groundwater samples collected from MW-215A and VAS-15, and

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2 CRA notes that the full vertical extent of the deeper vinyl chloride contamination (i.e., beyond 200 feet below ground surface) has not been fully delineated. Delineation of the vertical extent of deep groundwater contamination will be completed during the Remedial Investigation of Operable Unit Two (OU2 RI).

3 If the top of the till layer is located at a depth greater than 40 ft, CRA will attempt to advance the boreholes deeper than 40 ft if groundwater is not encountered within the first 40 ft.

concentrations in soil gas samples collected from GP12-09, GP13-09, and GP14-09. The source of the VOC concentrations in shallow groundwater in the vicinity of VAS-09 has not been identified.

CRA collected a soil gas sample from GP09-09 that contained TCE at a concentration of 2,000 $\mu g/m^3$. This concentration indicates that there may be a source of TCE on Lot 4610. GP09-09 is located approximately 150 ft from a residential property, and approximately 200 ft from a house with a basement foundation. GP09-09 is located at the Site boundary on Lot 4610, the location of the former Mantle Oil Service facility. Between 1971 and 1986, Mantle Oil Service operated a used oil reclamation service on Lot 4610, which included 18 above ground storage tanks.

In order to determine the concentration of shallow groundwater contaminants at the Site boundary within the Study Area, CRA will advance boreholes at horizontal distances no greater than 100 ft as shown on Figure 2. CRA will collect a groundwater sample from the top 5 ft of shallow groundwater at each borehole following the procedures detailed in Section 2.4.

2.3 BOREHOLE ADVANCEMENT

The proposed groundwater sampling locations are shown on Figures 2 and 3. All borings will be completed using Geoprobe™ direct push drilling techniques. Details regarding Geoprobe™ drilling are provided in Attachment A (addendum to the FSP).

The drill rods, stainless steel screen, and associated drilling equipment will be decontaminated, prior to starting and between each borehole, using a high-pressure, high temperature, hot water cleaner. The drilling contractor will use an off-Site source of potable water, which is free of contamination. CRA previously collected a sample of the nearby potable water source for analysis of VOCs to verify the water quality. In the event of a change in the potable water source, CRA will collect a sample from the new source.

During borehole advancement, continuous soil cores will be retrieved to log soil stratigraphy. CRA will screen the cores with a PID for the presence of VOCs, and also screen for the presence of methane, either by using a landfill gas meter (such as a Landtec GEM-2000, MultiRAE 4-Gas monitor, or equivalent) or a flame-ionization detector (FID) calibrated for methane.

Where field screening indicates evidence of contamination, CRA will test soils for the presence of non-aqueous phase liquids (NAPL) using a Sudan IV® dye test. Field calibration, preventative maintenance, and SOPs for the PID and Sudan IV® dye test are included in the FSP.

2.4 SHALLOW GROUNDWATER INVESTIGATION SAMPLE COLLECTION

Following the field screening and logging of the soil stratigraphy at each borehole, the Geoprobe will be offset approximately 1-foot from the borehole to collect a groundwater sample while preventing drawdown. CRA proposes to use a Geoprobe Screen Point 16 (SP16) Groundwater Sampler. The SOP for the Geoprobe SP16 Groundwater Sampler is included in Attachment A (addendum to the FSP). CRA proposes to use a 41-inch (3.4-ft) stainless steel slotted screen with the 51.5-inch (4.3-ft) Geoprobe SP16 Groundwater Sampler. CRA will collect groundwater samples from the top 5 ft of shallow groundwater. The sampling intake will be set approximately 2.5 ft below the water table, with the top of the 41-inch stainless steel screen set approximately 0.8 ft below the water table in order for the sampling intake to be set at the midpoint of the screen.

Groundwater samples will be collected through the stainless steel screen using a mechanical bladder pump set at a flow rate of 100 milliliters per minute (mL/min). The SOP for the bladder pump is included in Section 5.1 of Attachment A, and the Geoprobe model MB470 mechanical bladder pump SOP is included in Attachment A (addendum to the FSP).

The flow rate for purging of groundwater will be dependent on the capacity of the mechanical bladder pump and the transmissivity of the aquifer material. Efforts will be made to maintain low flow during purging (i.e., 100 to 500 mL/min for purging). The minimum required water volume (i.e., three to five screen volumes) will be purged at the lowest sustainable flow rate. During the screen purging, field parameters such as pH, temperature, specific conductance, and turbidity will be monitored to evaluate the stabilization of the purged groundwater. The groundwater will be considered stable after a maximum of five well screen volumes are removed or when three successive readings for pH, specific conductance, temperature, and turbidity agree within the following limits:

- pH: ±0.1 pH units
- Specific conductance: ±3 percent (temperature corrected)
- Temperature: ±1.0 °C
- Turbidity: ±10 percent of the average value of the three readings, or a final value of less than 5 NTU

pH, and temperature will be monitored using a YSI Model 3560 instrument. Turbidity will be measured using a HF Scientific DRT-15C Turbidimeter. Alternatively, equivalent instruments may be used.

For sampling intervals where the nature of the formation substantially restricts the flow of water during purging, purging will continue for a maximum of two hours. Groundwater samples will be collected once the parameters have stabilized as detailed in the FSP, or once the maximum purging time has been reached. Groundwater samples will not be collected if attempts to purge and sample indicate the interval does not yield enough water to sample. If this occurs, the borehole location will be resituated, and another attempt to collect a groundwater sample will be made.

All shallow groundwater investigation samples will be analyzed for Target Compound List (TCL) VOCs and naphthalene on a regular turnaround time basis.

CRA will collect a groundwater sample from the water supply well located at 2447 East River Road via a tap, if present. CRA will confirm with a representative from 2447 East River Road that the water from the tap is not altered by any method including water treatment devices (i.e., water softeners, filtration units, ultraviolet light, reverse osmosis, distillers, chlorinators, etc.), and therefore, is representative of the groundwater in the aquifer in which the water supply well is screened. Attachment B presents the SOP for residential or water supply well sampling.

If water treatment devices are present and a sample cannot be collected from a tap or other location upstream of any such devices, CRA will collect a groundwater sample directly from the water supply well through the use of a bladder pump. The SOP for the bladder pump is included in Attachment A (addendum to the FSP). CRA will submit the groundwater sample from the water supply well for TCL VOCs, naphthalene, and metals analyses on a regular turnaround time basis.

For QA/QC purposes, CRA will submit one field duplicate for every 10 groundwater samples submitted. Based on the total expected number of groundwater samples to be collected during borehole advancement, CRA will submit three field duplicate groundwater samples. CRA will also submit one trip blank sample per shipment for VOC analyses to assess the sample handling procedures.

The results of the Shallow Groundwater Investigation will be evaluated to identify locations within the study boundary where concentrations of VOCs or naphthalene in shallow groundwater at the Site boundary pose a risk to receptors via the VI pathway greater than a 1×10^{-6} excess cancer risk or a HI of 1 for a residential exposure scenario. CRA will determine these risks by comparing groundwater sample concentrations to calculated groundwater target risks concentrations (Risk=10^{-6}, HI=1). CRA will calculate the groundwater target risk concentrations using the calculations provided in Appendix D of OSWER Draft Guidance. CRA will calculate the groundwater target risk concentrations by dividing the USEPA Residential Air

RSLs by a reasonably-conservative media-specific factor of 0.001, then converting the vapor concentration to an equivalent groundwater concentration assuming equilibrium between the aqueous and vapor phases at the water table. If the risk-based concentrations calculated for groundwater fall below the chemical's MCL, CRA will use the MCL as the target concentration, in accordance with the OSWER draft guidance.

Following completion of the Shallow Groundwater Investigation, CRA will recommend any additional temporary boreholes, permanent monitoring wells, soil vapor investigation, or remediation required in order to further define or mitigate unacceptable risks posed by contaminants in shallow groundwater at the Site boundary between VAS-09 and VAS-22, and in the vicinity of MW-210. Any additional investigation that is deemed necessary based on the results of the Shallow Groundwater Investigation will be completed on an expedited basis outside of the OU2 Remedial Investigation process unless otherwise agreed between the Respondents and USEPA.

2.5 SHALLOW GROUNDWATER INVESTIGATION SCHEDULE

CRA will commence field work within three weeks of receipt of USEPA approval of the Work Plan, dependant on drilling subcontractor availability, and obtaining access to the various private properties and businesses.

If any significant changes or modifications to the proposed scope of work presented herein are required, CRA will contact USEPA for approval prior to implementing the changes.

2.6 SHALLOW GROUNDWATER INVESTIGATION REPORTING

CRA will post the validated analytical results to the South Dayton Dump and Landfill ftp site upon validation. CRA will also post stratigraphic information to the ftp site as soon as it is compiled from the field notes. The Respondents will submit the draft Shallow Groundwater Investigation Report to USEPA within 30 days of receipt of the final laboratory data report.

The draft Shallow Groundwater Investigation Report will provide a summary of results from the Shallow Groundwater Investigation, and recommendations for further sampling or remedial actions required to identify and address unacceptable risks to on- or off-Site receptors. CRA will finalize the Report following receipt of comments from USEPA. The monthly progress reports required by the ASAOC will include information about this investigation.

CRA will provide recommendations in the Report detailing additional characterization required based on the findings of the Shallow Groundwater Investigation.

Should you have any questions on the above, please do not hesitate to contact us.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Stephen M. Quigley

VC/ca/96
Encl.

cc: Tim Prendiville, USEPA
Laura Marshall, Ohio EPA
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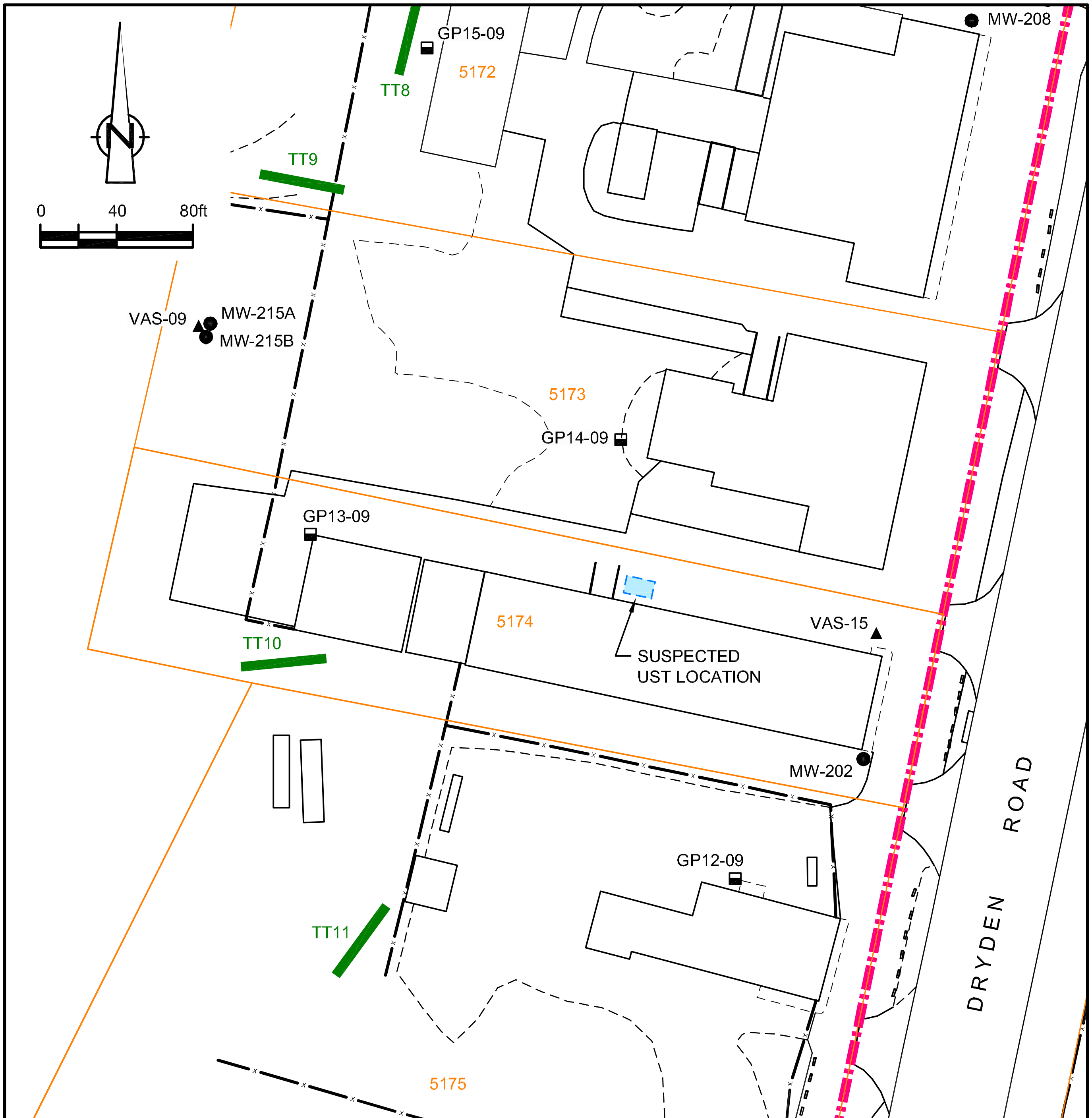
Paul Jack, Castle Bay
Robin Lunn, Winston & Strawn
Bryan Heath, NCR
Karen Mignone, Verrill Dana
Adam Loney, CRA
Jim Campbell, EMI



LEGEND

APPROXIMATE SITE BOUNDARY

PARCEL BOUNDARY

3696 PARCEL NUMBER

MW-206 UPPER AQUIFER MONITORING WELL LOCATION

VAS-01 VERTICAL AQUIFER SAMPLING LOCATION

GP04-09 DEEP LANDFILL GAS PROBE

TT9 TEST TRENCH LOCATION

figure 1

APPROXIMATE LOCATION OF SUSPECTED UST
SOUTH DAYTON DUMP AND LANDFILL SITE
Moraine, Ohio

SOURCES:
THE PAYNE FIRM, INC., PROJECT 0279.44.05, FIGURE 1, DATED 9/12/05;
TETRA TECH EM INC., PROJECT L0312006-SOUTH DAYTON DUMP, FIGURE 2, SITE LAYOUT, 05/25/2004;
CITY OF MORAINE.
ABRAMS AERIAL SURVEY INC. PROJECT 38443, AASI 29610, 04/02/2008

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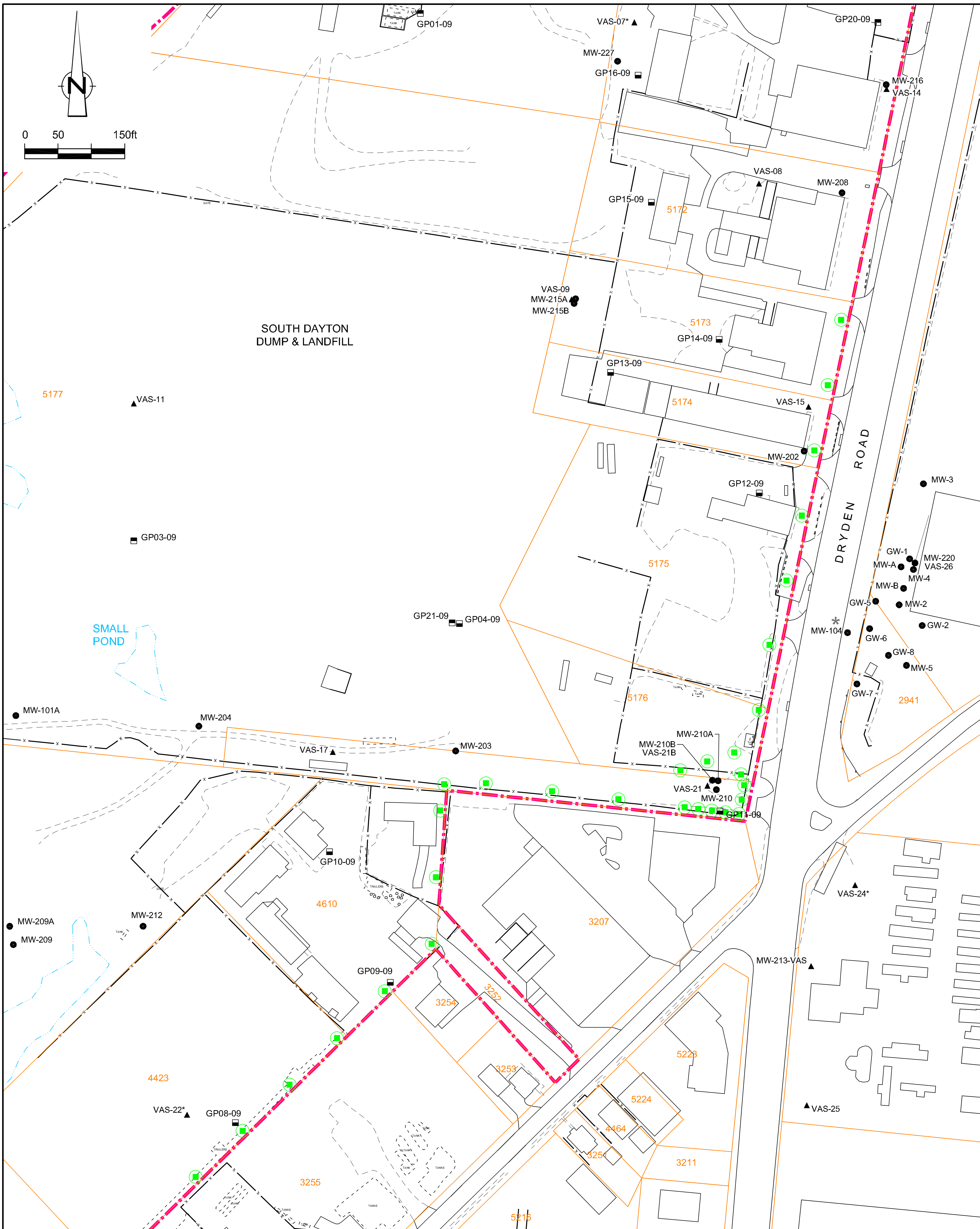

LEGEND

APPROXIMATE SITE BOUNDARY

EDGE OF WATER

PARCEL BOUNDARY

3696 PARCEL NUMBER

MW-206 UPPER AQUIFER MONITORING WELL LOCATION

VAS-01 VERTICAL AQUIFER SAMPLING LOCATION

* VAS LOCATION COMPLETED TO 70 FEET BELOW GROUND SURFACE OR LESS

GP21-09 SHALLOW LANDFILL GAS PROBE

GP04-09 DEEP LANDFILL GAS PROBE

PROPOSED TEMPORARY SHALLOW GROUNDWATER SAMPLING LOCATION

figure 2

PROPOSED GROUNDWATER SAMPLING LOCATIONS
SOUTH DAYTON DUMP AND LANDFILL SITE
Moraine, Ohio

CRA

SOURCES:
THE PAYNE FIRM, INC., PROJECT 0279.44.05, FIGURE 1, DATED 9/12/05;
TETRA TECH EM INC., PROJECT L0312006-SOUTH DAYTON DUMP, FIGURE 2, SITE LAYOUT, 05/25/2004;
CITY OF MORAINE.
ABRAMS AERIAL SURVEY INC. PROJECT 38443, AASI 29610, 04/02/2008

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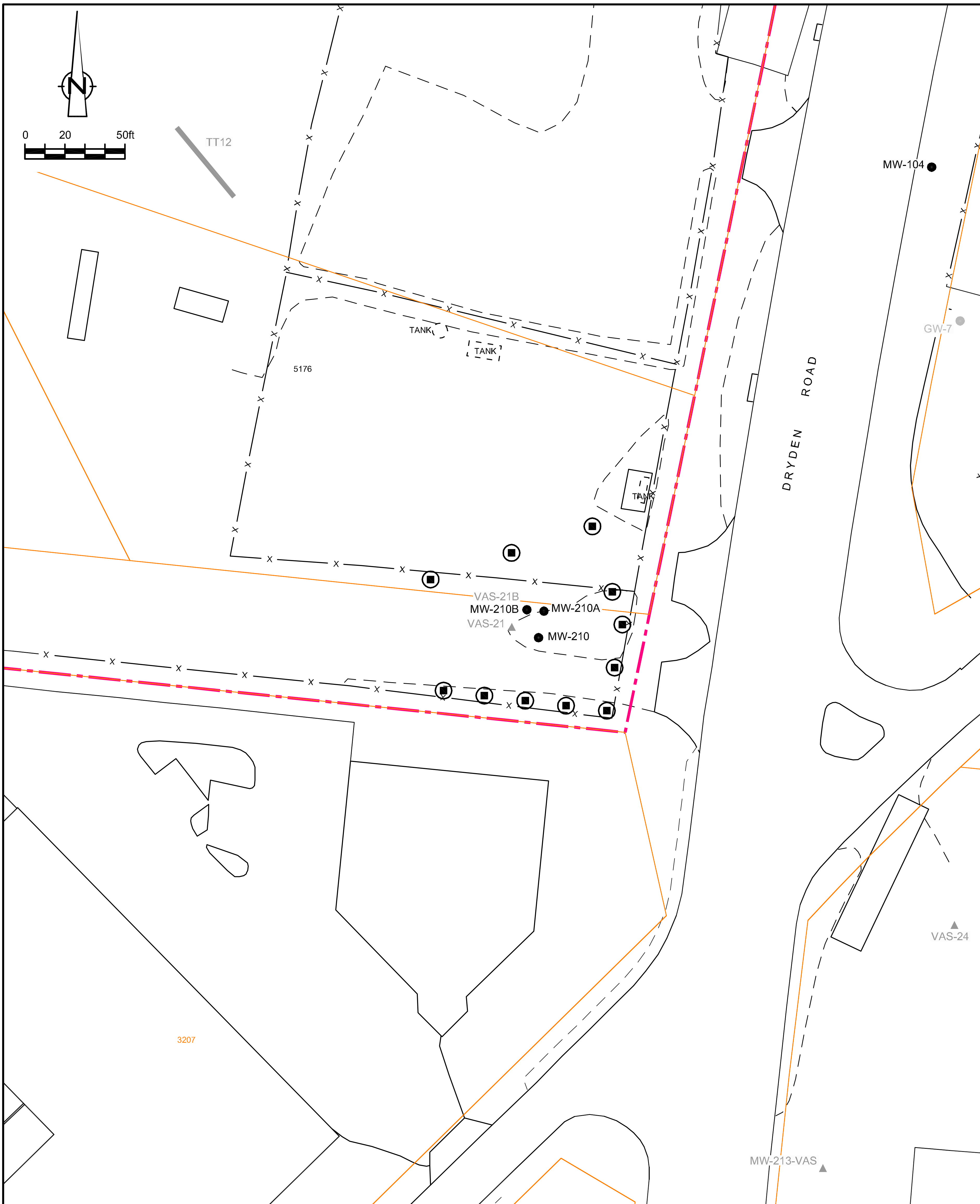

LEGEND

SITE BOUNDARY (SOW 2006)

EDGE OF WATER

PARCEL BOUNDARY

MW-206 MONITORING WELL LOCATION

MW-1 HISTORIC DP&L MONITORING WELL LOCATION

TT1 TEST TRENCH LOCATION

VAS01 VERTICAL AQUIFER SAMPLING LOCATION

PROPOSED TEMPORARY SHALLOW GROUNDWATER SAMPLING LOCATION (NOTE THAT ADDITIONAL LOCATIONS MAY BE ADDED BETWEEN THE LOCATIONS SHOWN TO BETTER DELINEATE THE PLUME)

figure 3

PROPOSED MW-210 BOREHOLE LOCATIONS
SOUTH DAYTON DUMP AND LANDFILL SITE
Moraine, Ohio

SOURCES:
THE PAYNE FIRM, INC., PROJECT 0279.44.05, FIGURE 1, DATED 9/12/05;
TETRA TECH EM INC., PROJECT L0312006-SOUTH DAYTON DUMP, FIGURE 2, SITE LAYOUT, 05/25/2004;
CITY OF MORAINE.
ABRAMS AERIAL SURVEY INC. PROJECT 38443, AASI 29610, 04/02/2008

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ATTACHMENT A

VERTICAL AQUIFER SAMPLING/TEMPORARY MONITORING
WELL INSTALLATION AND SAMPLING BY GEOPROBE®

ATTACHMENT A

STANDARD OPERATING PROCEDURE FOR VERTICAL AQUIFER SAMPLING /TEMPORARY MONITORING WELL INSTALLATION AND SAMPLING BY GEOPROBE®

1.0 INTRODUCTION

Shallow vertical aquifer sampling (VAS) boreholes and temporary monitoring wells may be installed via direct-push Geoprobe methods.

Direct-push (a.k.a., Geoprobe) refers to the sampler being "pushed" into the soil material without the use of drilling to remove the soil. This method relies on the drill unit static weight, combined with rapid hammer percussion, to advance the tool string. Discrete soil samples are continuously obtained. It is important that the direct-push drilling method (i.e., Geoprobe) used minimizes the disturbance of subsurface materials.

This method is used extensively for initial site screening to establish site geology and delineate vertical and horizontal plume presence.

Standard Penetration Test (SPT) blow count values cannot be obtained when sampling with a direct-push discrete soil sampler.

The direct-push method is popular due to the limited volume of cuttings produced and the speed of the sampling process, which can be much faster than the sample description and sample preparation process.

Discrete continuous soil samples are collected in tube samplers (various lengths) affixed with a cutting shoe and internal liner [polyvinyl chloride (PVC), Teflon, or acetate are available]. The soil sampler may be operated in "open-mode" (when borehole collapse is not a concern), or in "closed-mode" (when minimization of sample "slough" is desired). Closed-mode operation involves placement of a temporary drill-point in the cutting shoe and driving the assembled sampler to depth. At the required depth, the temporary drill–point is released (via internal threading) and the sampler is driven to the desired soil interval. The drill-point slides inside the sample liner, riding above the collected soil column. Once driven to depth, the sampler is retrieved to the ground surface and the sample liner, with soil, is removed for examination. Extra care must be taken when cutting open the sample tube; no open blade cutting tools may be used in the process, you must have an appropriate stabilizer/holder for the tube, and cut resistant hand protection must be included as part of the overall PPE.

The Geoprobe drilling method should not contaminate the subsurface soils and groundwater. It is extremely important that drilling does not create a hydraulic link or conduit between different hydrostratigraphic units. Groundwater in monitoring and extraction wells must not be contaminated by drilling fluids or the borehole advancement process. Geoprobe drilling equipment will be decontaminated before use and between locations to prevent cross-contamination between VAS boreholes or temporary monitoring well locations and sites. Geoprobe drilling equipment will be decontaminated between well locations regardless of whether or not contaminants are suspected. Section 7.0 in the FSP specifies the required decontamination procedures. At a minimum, decontamination procedures detailed in Section 7.0 of the FSP should be used during monitoring well design and construction.

A Geoprobe SP16 will be used for shallow VAS and temporary monitoring well activities. The SOP for the Geoprobe SP16 Groundwater Sampler is included in Attachment A (addendum to the FSP). The Geoprobe SP16 is a direct push groundwater sampling device that consists of a well screen inside a steel sheath that is driven to the desired sample depth using standard Geoprobe rods. The assembled Geoprobe SP16 sampler is 51.5 inches long. The Geoprobe SP16 is then deployed by retracting the steel sheath and exposing the well screen directly to the formation. Generally, up to 41-inches of well screen can be exposed. Groundwater samples will be collected through the stainless steel screen using a mechanical bladder pump set at a flow rate of 100 milliliters per minute (mL/min). A peristaltic pump may also be used as an alternate pump method as it is generally acceptable for purging wells, however, peristaltic pumps have limited ability to collect VOC and SVOC samples. The SOPs for the mechanical bladder pump and peristaltic pump are included below in Sections 5.1, and 5.2, respectively. The VAS or temporary monitoring well location will then be abandoned using grouting. The SOP for grouting is included in Section 5.3, below.

Finally, if a permanent monitoring well is required, pre-cleaned construction materials are used in order to prevent the potential introduction of contaminants into a hydrostratigraphic unit. Permanent monitoring well installation is discussed in Section 2.7 of the FSP.

2.0 PLANNING AND PREPARATION

Prior to undertaking shallow VAS or temporary groundwater monitoring well installation and sampling utilizing a Geoprobe the following procedures will be followed:

1. Review the appropriate Work Plan and Site-Specific Heath and Safety Plan (HASP), project documents, all available geologic and hydrogeologic mapping and reports, water well records, and historic site reports to become familiar with the geologic and hydrogeologic framework of the site and surrounding area. Review and become familiar with the health and safety requirements, and discuss the work activities with the Project Coordinator.
2. Assemble all required equipment, materials, log books, and forms.
3. Obtain a site plan and previous stratigraphic logs. Determine the exact number, location, and depth of wells to be installed.
4. If not performed as part of borehole advancement, complete a Property Access/Utility Clearance Data Sheet. In most instances, the utility clearances and property access will have been completed as part of the well drilling and advancements.
5. Determine notification requirements with the Project Coordinator. Have all regulatory groups, the client, landowner, drilling contractor, and CRA personnel been informed of the well design and installation program?
6. Determine the methods for handling and disposal of cuttings, purged groundwater, and decontamination fluids. Generally, this is dealt with as part of the well advancement activities.

In addition to the above, the following may be required when conducting VAS or temporary monitoring well installation and sampling activities:

1. Establish a water source for well installation and decontamination. Pre-plan the methods of handling and disposal of well installation and decontamination fluids.
2. Arrange with the drilling contractor/client to provide a means of containment and disposal of fluids.

3.0 EQUIPMENT DECONTAMINATION

Prior to use and between each borehole location, drilling and sampling equipment must be decontaminated in accordance with Section 7.0 of the FSP.

4.0 LOCATION AND MARKING OF VAS/TEMPORARY MONITORING WELL SITES/FINAL VISUAL CHECK

The proposed investigative locations marked on the site plan are located and staked in the field. This should be completed several days prior to the drill rig arriving on site. Investigative locations are required for the completion of utility locates. Generally, VAS or temporary monitoring well locations are strategically placed to assess site hydrogeologic conditions.

Once the final VAS or temporary monitoring well location has been selected and utility clearances are complete, one last visual check of the immediate area should be performed before drilling proceeds to confirm the locations of adjacent utilities (subsurface or overhead) and verify adequate clearance. If gravity sewers or conduits exist in the area, access manholes or chambers should be opened and the conduit/sewer alignments confirmed. Do not enter manholes unless confined space procedures are followed.

When possible, it is prudent to use a hand auger or post-hole digging equipment to a sufficient depth to confirm that there are no buried utilities or pipelines. This is particularly important in limited space sites where wells are being installed close to buried utilities. Alternatively, a Hydrovac truck can vacuum a large diameter hole to check for utilities, although soils collected this way may require containment on site. This procedure generally clears the area to the full diameter of the drilling equipment which will follow.

> ***Caution**: Do not assume that site plan details regarding pipe alignment/position are correct. Visually inspect pipe alignment when advancing boreholes near sewers. Be prepared to find additional piping if outdated plans are being used. If possible confirm pipe locations with on-site employees or a client representative.*

Investigative locations are selected primarily to provide a good geographical distribution across the site. Most often, the VAS or temporary monitoring well locations specified in the Work Plan are not pre-verified to confirm clearance from underground or overhead utilities, or to consider site-specific physical characteristics (e.g., traffic patterns, drainage patterns). Consequently, it is the Field Supervisor's responsibility to perform the following:

1. Select the exact location of each well consistent with the site and project requirements.
2. If a VAS or temporary monitoring well location must be relocated more than 20 feet (5.7 m) from the initially identified location, confirm the new location's suitability with the Project Coordinator.

3. Ensure all utilities have been cleared prior to initiating borehole advancement activities.

To the extent practical, wells should be located adjacent to permanent structures (e.g., fences, buildings) that offer some form of protection and a reference point for future identification. Wells located in high traffic areas or road allowances or low-lying wet areas are undesirable, but may be unavoidable.

5.0 PROCEDURES FOR VERTICAL AQUIFER SAMPLING/TEMPORARY MONITORING WELL INSTALLATION AND SAMPLING BY GEOPROBE

The direct push procedure will use the Geoprobe, as follows:

1. The direct push drill rig will advance the borehole using methods consistent with ASTM Standard D6724-04 (Appendix J-H-4 of the FSP).
2. The direct push borehole will be advanced from ground surface to the top five feet of shallow groundwater. Soil cores will be collected using Geoprobe® MacroCore® sampling techniques or equivalent. Soil cores will be collected throughout the entire length of the borehole.
3. Representative samples will be logged immediately after opening the acetate liner. Field measurements of undifferentiated VOCs will be conducted by placing representative soil samples into a closed sample container and allowing them to equilibrate. The VOCs in the headspace will then be measured by placing the wand of the PID into the headspace. Field calibration, preventative maintenance, and SOPs for the PID are contained in Section 6.0 of the FSP.
4. The soil core will be logged by CRA personnel and soils will be classified using the USCS in accordance with ASTM Method D-2488-06 (Appendix J-H-2). Soil stratigraphy will be described on an Overburden Stratigraphy Log, an example of which is in Appendix J-G of the FSP.
5. Following the field screening and logging of the soil stratigraphy at each borehole, the Geoprobe will be offset approximately 1 foot from the borehole in order to collect a groundwater sample while preventing drawdown. CRA will operate the Geoprobe SP16 sampler in accordance with the Geoprobe SOP included in Attachment A. The maximum exposable Geoprobe screen length is approximately 41-inches (3.4 ft). The sample intake will be set at 2.5 feet below the water table, with the top of the 41-inch stainless steel Geoprobe SP16 Groundwater sampler screen set approximately 0.8 ft below the water table, in order for the sampling intake to be set at the midpoint of the screen. CRA will

set the pump intake at the middle of the well screen (i.e., 1.7 feet below the top of the well screen).

6. A pre-cleaned Geoprobe® SP16 groundwater sampler will be assembled as per manufacturer's operational procedure. A description of the Geoprobe® SP16 is provided in Section 1.0 of this SOP.

7. New 1/4-inch diameter tubing will be installed and attached to a bladder pump. A peristaltic pump may be used as an alternate method; however, peristaltic pumps have limited ability to collect VOC and SVOC samples. The SOPs for the mechanical bladder pump and peristaltic pumps are included in Sections 5.1, and 5.2, respectively, below. The Geoprobe model MB470 mechanical bladder pump SOP is included in Attachment A. Groundwater will be purged from the Geoprobe® SP16 groundwater sampler using the pump. A minimum of three to five screen point well volumes will be purged at the same rate as the low flow sampling prior to commencing stabilization monitoring. At the start of purging, the purge water is visually inspected for clarity, prior to connecting to the flow-through cell. If the purge water is turbid, low-flow purging continues until the purge water is visually less turbid, prior to connecting to the flow-through cell. Field measurements of pH, conductivity, turbidity, and temperature will be collected at approximate 5-minute intervals once the flow-through cell is connected. If it is apparent that stabilization will not be achieved quickly, stabilization parameter measurements may be made at a greater time interval. Stabilization monitoring will be performed using a flow-through-cell. All field measurements will be recorded in the field book.

   The groundwater will be considered stable after a maximum of five well volumes are removed or when three successive readings for pH, specific conductance, turbidity, and temperature agree within the following limits:

   - pH: ± 0.1 pH unit
   - Specific conductance: ± 3% (temperature corrected)
   - Temperature: ± 1.0 °C
   - Turbidity: ±10 percent of the average value of the three readings, or a final value of less than 5 NTU

9. Once field parameters have stabilized, groundwater samples will be collected directly from the bladder pump discharge line in laboratory-supplied, analyte-specific sample containers and preserved according to laboratory requirements. If peristaltic pumps are used for purging, VOC and SVOC samples will be collected with a stainless steel bottom loading bailer. The peristaltic pump can then be used to collect the remaining sample analytes.

10. VAS and temporary monitoring well samples will be analyzed for parameters detailed in the Work Plan. The Geoprobe® SP16 groundwater sampler will be decontaminated between samples following the procedures in Section 7.0 of the FSP.
11. Upon reaching the total depth of the VAS or temporary monitoring well location, the downhole equipment will be removed from the borehole and the borehole will be backfilled with pure bentonite slurry grout in accordance with Section 5.3.
12. All downhole equipment such as drill rods and sample tools will be decontaminated as discussed in Section 7.0 of the FSP.
13. Drill cuttings and decontamination water will be managed as discussed in Section 8.0 of the FSP.

5.1 BLADDER PUMPS

Bladder pumps are driven by compressed air or nitrogen but the air or nitrogen does not come in contact with the groundwater. The contact between the air or nitrogen and the groundwater is eliminated by the presence of a Teflon™, polyethylene, or natural rubber bladder. The pump operation is cyclic and is controlled using a control box at ground surface. The control box controls the pump filling and discharge time. Because the air or nitrogen does not come in direct contact with the groundwater, and there is limited groundwater agitation and degassing, a bladder pump is the best sampling equipment for the collection of groundwater samples for VOC and SVOC analysis.

Bladder pump operation is very quiescent, causing little formation and well disturbance. By using a bladder pump, collecting a sediment-free groundwater sample is easily achieved. An adjustable rate bladder pump should be used for low-flow purging. Bladder pumps generally are only able to achieve a maximum pumping rate of 1.5 USgpm (5.7 L/min). It is important to note that flow rates should be reduced in deep well applications.

Well purging and sampling can be performed using a bladder pump. Once sampling is completed, the pump should be disassembled and decontaminated in accordance with the Work Plan or QAPP prior to use in other wells. The sample tubing is generally 1/4- or 3/8-inch (6 or 10 mm) diameter polyethylene or Teflon™ lined polyethylene tubing. The air line is generally 1/4-inch (6 mm) polyethylene tubing. The sample and air line tubing are typically suspended in the well for future use (dedicated). At some sites a complete sampling system (bladder pump, discharge tubing, and air line) is dedicated to each permanent well.

Bladder pumps provide excellent sample quality and are useful in deeper sampling applications. There are no analyte restrictions. Bladder pumps are strongly recommended for low-flow purging applications.

Bladder pumps require additional equipment including control box, compressed air or nitrogen, and tubing. The setup of a bladder pump is quite labor intensive unless a dedicated system is in place. Decontamination of a bladder pump requires pump disassembly and re-assembly. Finally, bladder pumps are not capable of high flow rates, thus purging times tend to be increased slightly.

5.2 PERISTALTIC PUMPS

A peristaltic pump is acceptable for purging wells and for most groundwater sample analytes. The groundwater sampler must ensure that a peristaltic pump is acceptable to regulatory agencies with local jurisdiction for VOC and SVOC sample collection. The peristaltic pump is only to be used as an alternate pump method, with the approval of USEPA, or USEPA's oversight consultant, CH2M Hill.

A peristaltic pump is capable of lifting water from a maximum depth of 25 feet (7.6 m) below ground surface or the pump, whichever is greater. A peristaltic pump is a self-priming, low volume, suction pump which consists of a rotor with ball bearing rollers. Flexible silicon tubing is inserted around or in the pump rotor and squeezed in place by the heads as they revolve in a circular pattern. The section of silicon tubing must not exceed 3 feet (0.9 m) in length. Additional rigid polyethylene or Teflon™ tubing is attached to the flexible tubing and placed in the well. Another piece of rigid tubing is attached to the discharge end of the flexible silicon tubing to facilitate sample collection. The entire length of rigid and flexible silicon tubing may be dedicated to the well for future use or disposed of at the completion of sampling. If retained, the tubing is typically tied and suspended in the well. The flexible or rigid tubing is not reused in other wells because cross-contamination will occur.

Liquid is pulled into the tubing by the peristaltic pump through the creation of a vacuum as the rotor head turns. An advantage of using a peristaltic pump is that no pump parts come in direct contact with the sample. A peristaltic pump is capable of providing low flow sampling rates (i.e., typically less than 500 mL/min) with less agitation than other suction pumps. However, it is important that the tubing is secured during pumping to prevent the tubing from moving and causing agitation. A peristaltic pump also allows for regulation of the flow rate by increasing or decreasing the rotor head speed.

Peristaltic pumps are small and easily mobilized to remote sample locations. They require minimal setup, and do not require decontamination between sample locations. The disadvantages of a peristaltic pump are its limited lift and flow capabilities and the limited ability to collect VOC and SVOC samples. Peristaltic pumps may only be used with the approval of USEPA or USEPA's oversight consultant, CH2M Hill. If using a peristaltic pump for purging, and the collection of VOCs and SVOC samples with the peristaltic pump is not acceptable, it is common to collect the initial VOC and SVOC analytes with a stainless steel bottom loading bailer. The peristaltic pump can then be used to collect the remaining sample analytes.

Peristaltic pumps are becoming more popular for low-flow purging. However, it should be noted that a peristaltic pump may cause degassing, pH modification, and possible VOC loss.

5.3 GROUTING

Boreholes or annular space between the well casing and borehole wall must be filled with bentonite slurry grout. In accordance with Ohio Administrative Code (OAC) No. 3745-9-07, bentonite grout shall not contain bentonite drilling mud or cuttings. The following bentonite grout is allowable for use under OAC 3745-9-07(A)(2):

> *(2) Bentonite grouts that have standard ANSI/NSF 60 certification, and include:*
> *(a) High solids bentonite grout using powdered bentonite clay or granular bentonite; or*
> *(b) Coarse grade or pelletized bentonite.*

Bentonite grout does not crack or harden and is generally self healing. Cement/bentonite grout may crack, but bentonite will typically seal any cracks. Cement/bentonite grout must contain at least 5 percent bentonite volume by weight. Neat cement will crack and may pull away from riser pipe or borehole wall.

Grouting procedures for the Geoprobe SP16 sampler are contained in Sections 4.7 and 4.8 of Geoprobe SOP included in Attachment A.

There are several methods for borehole abandonment. Following preparation of grout in accordance with the manufacturer's specifications, one of the following methods may be used for borehole abandonment:

- Use a positive displacement pump to deliver grout with positive pressure to the bottom of the borehole
- Place bentonite pellets through a conductor pipe into water-filled, uncased boreholes

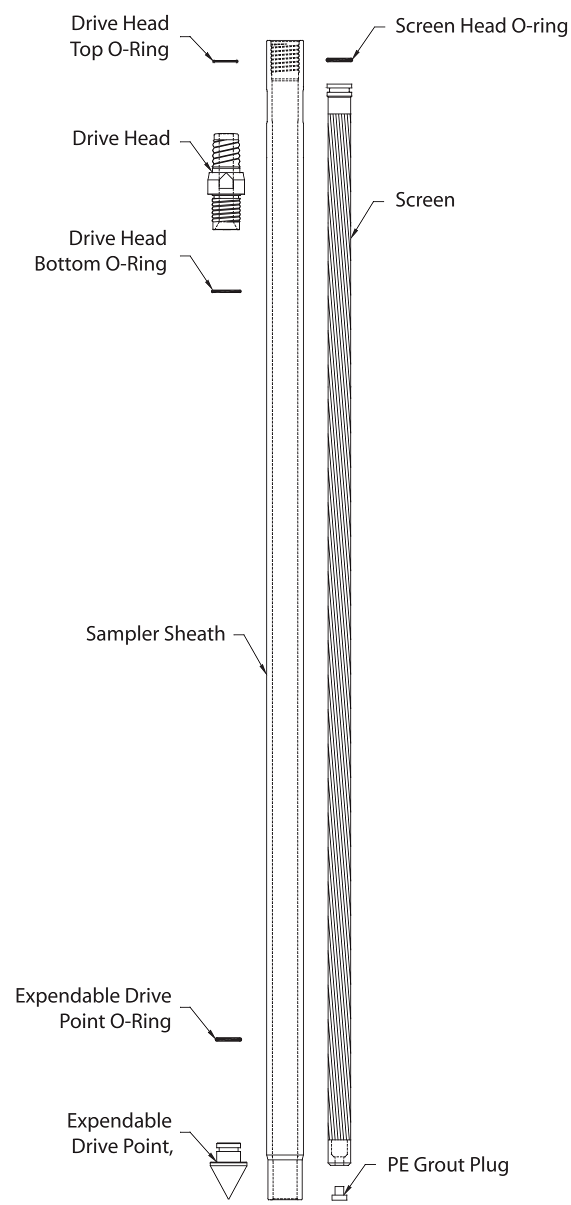
- Use direct gravity placement in boreholes that are free of water and in deeper boreholes that have sufficient open diameter to prevent bridging

GEOPROBE® SCREEN POINT 16 GROUNDWATER SAMPLER

STANDARD OPERATING PROCEDURE

Technical Bulletin No. MK3142

PREPARED: November, 2006



GEOPROBE® SCREEN POINT 16 GROUNDWATER SAMPLER PARTS

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Screen Point 16 Groundwater Sampler is manufactured under U.S. Patent 5,612,498

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1.0 OBJECTIVE

The objective of this procedure is to drive a sealed stainless steel or PVC screen to depth, deploy the screen, obtain a representative water sample from the screen interval, and grout the probe hole during abandonment. The Screen Point 16 Groundwater Sampler enables the operator to conduct abandonment grouting that meets American Society for Testing and Materials (ASTM) Method D 5299 requirements for decommissioning wells and borings for environmental activities (ASTM 1993).

2.0 BACKGROUND

2.1 Definitions

Geoprobe®: A brand name of high quality, hydraulically powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and monitoring, soil conductivity and contaminant logging, grouting, and materials injection.

Screen Point 16 (SP16) Groundwater Sampler: A direct push device consisting of a PVC or stainless steel screen that is driven to depth within a sealed, steel sheath and then deployed for the collection of representative groundwater samples. The assembled SP16 Sampler is approximately 51.5 inches (1308 mm) long with an OD of 1.625 inches (41 mm). Upon deployment, up to 41 inches (1041 mm) of screen can be exposed to the formation. The Screen Point 16 Groundwater Sampler is designed for use with 1.5-inch probe rods and machines equipped with the more powerful GH60 Hydraulic Hammer. Operators with GH40 Series hammers may chose to use this sampler in soils where driving is difficult.

Rod Grip Pull System: An attachment mounted on the hydraulic hammer of a direct push machine which makes it possible to retract the tool string with extension rods or flexible tubing protruding from the top of the probe rods. The Rod Grip Pull System includes a pull block with rod grip jaws that are bolted directly to the machine. A removable handle assembly straddles the tool string while hooking onto the pull block to effectively grip the probe rods as the hammer is raised. A separate handle assembly is required for each probe rod diameter.

2.2 Discussion

In this procedure, the assembled Screen Point 16 Groundwater Sampler (Fig. 2.1A) is threaded onto the leading end of a Geoprobe® probe rod and advanced into the subsurface with a Geoprobe® direct push machine. Additional probe rods are added incrementally and advanced until the desired sampling interval is reached. While the sampler is advanced to depth, O-ring seals at each rod joint, the drive head, and the expendable drive point provide a watertight system. This system eliminates the threat of formation fluids entering the screen before deployment and assures sample integrity.

Once at the desired sampling interval, extension rods are sent downhole until the leading rod contacts the bottom of the sampler screen. The tool string is then retracted approximately 44 inches (1118 mm) while the screen is held in place with the extension rods (Fig. 2.1B). As the tool string is retracted, the expendable point is released from the sampler sheath. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired.

There are three types of screens that can be used in the Screen Point 16 Groundwater Sampler. Two of the these, a stainless steel screen with a standard slot size of 0.004 inches (0.10 mm) and a PVC screen with a standard slot size of 0.010 inches (0.25 mm), are recovered with the tool string after sampling. The third screen is also manufactured from PVC with a standard slot size of 0.010 inches (0.25 mm), but is designed to be left downhole when sampling is complete. This disposable screen has an exposed screen length of approximately 43 inches (1092 mm). The two screens that are recovered with the sampler both have an exposed screen length of approximately 41 inches (1041 mm).

(continued on following page)

An O-ring on the head of the stainless steel screens maintains a seal at the top of the screen. As a result, any liquid entering the sampler during screen deployment must first pass through the screen. PVC screens do not require an O-ring because the tolerance between the screen head and sampler sheath is near that of the screen slot size.

The screens are constructed such that flexible tubing, a mini-bailer, or a small-diameter bladder pump can be inserted into the screen cavity. This makes direct sampling possible from anywhere within the saturated zone. A removable plug in the lower end of the screens allows the user to grout as the sampler is extracted for further use.

Groundwater samples can be obtained in a number of ways. A common method utilizes polyethylene (TB25L) or Teflon® (TB25T) tubing and a Check Valve Assembly (GW4210). The check valve (with check ball) is attached to one end of the tubing and inserted down the casing until it is immersed in groundwater. Water is pumped through the tubing and to the ground surface by oscillating the tubing up and down.

An alternative means of collecting groundwater samples is to attach a peristaltic or vacuum pump to the tubing. This method is limited in that water can be pumped to the surface from a maximum depth of approximately 26 feet (8 m). Another technique for groundwater sampling is to use a stainless steel Mini-Bailer Assembly (GW41). The mini-bailer is lowered down the inside of the casing below the water level where it fills with water and is then retrieved from the casing.

The latest option for collecting groundwater from the SP16 sampler is to utilize a Geoprobe® MB470 Series Mechanical Bladder Pump (MBP)*. The MBP may be used to meet requirements of the low-flow sampling protocol (Puls and Barcelona 1996, ASTM 2003). Through participation in a U.S. EPA Environmental Technology Verification study, it was confirmed that the MB470 can provide representative samples (EPA 2003).

**The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

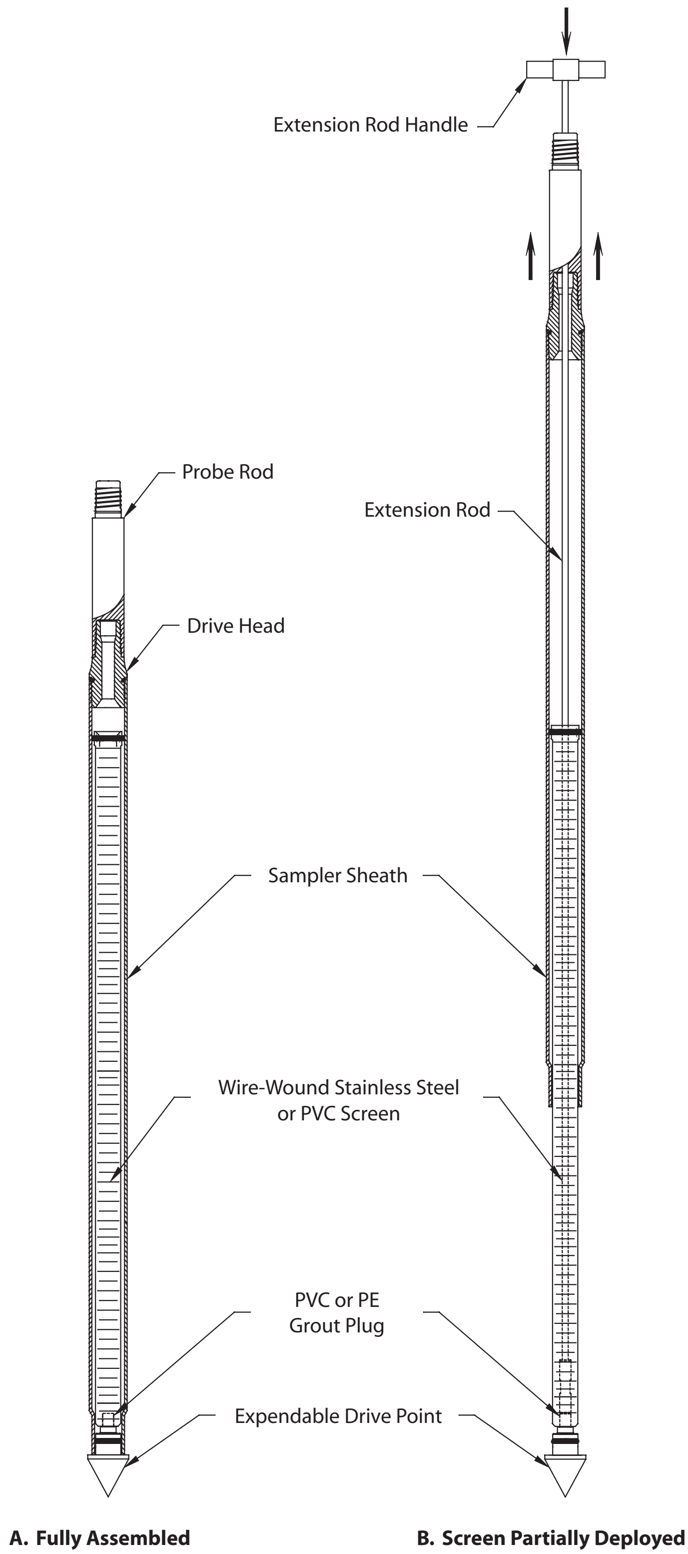


FIGURE 2.1
Screen Point 16 Groundwater Sampler

3.0 TOOLS AND EQUIPMENT

The following tools and equipment can be used to successfully recover representative groundwater samples with the Geoprobe® Screen Point 16 Groundwater Sampler. Refer to Figures 3.1 and 3.2 for identification of the specified parts. Tools are listed below for the most common SP16 / 1.5-inch probe rod configurations. Additional parts for optional rod sizes and accessories are listed in Appendix A.

SP16 Sampler Parts	**Part Number**
SP16 Sampler Sheath	15187
SP16 Drive Head, 0.5-inch bore, 1.5-inch rods*	18307
SP16 O-ring Service Kit, 1.5-inch rods *(includes 4 each of the O-ring packets below)*	15844
O-rings for Top of SP16 Drive Head, 1.5-inch rods only (Pkt. of 25)	*15389*
O-rings for Bottom of SP16 Drive Head (Pkt. of 25)	*13196*
O-rings for GW1520 Screen Head (Pkt. of 25)	*GW1520R*
O-rings for SP16 Expendable Drive Point (Pkt. of 25)	*GW1555R*
Screen, Wire-Wound Stainless Steel, 4-Slot*	GW1520
Grout Plugs, PE (Pkg. of 25)	GW1552K
Expendable Drive Points, steel, 1.625-inch OD (Pkg. of 25)*	GW1555K
Screen Point 16 Groundwater Sampler Kit, 1.5-inch Probe Rods *(includes 1 each of: 15187, 18307, 15844, GW1520, GW1535, GW1540, GW1555K, and GW1552K)*	15770

Probe Rods and Probe Rod Accessories	**Part Number**
Drive Cap, 1.5-inch probe rods, threadless, (for GH60 Hammer)	12787
Pull Cap, 1.5-inch probe rods	15090
Probe Rod, 1.5-inch x 60-inch*	11121

Extension Rods and Extension Rod Accessories	**Part Number**
Screen Push Adapter	GW1535
Grout Plug Push Adapter	GW1540
Extension Rod, 60-inch*	10073
Extension Rod Coupler	AT68
Extension Rod Handle	AT69
Extension Rod Jig	AT690
Extension Rod Quick Link Coupler, pin	AT695
Extension Rod Quick Link Coupler, box	AT696

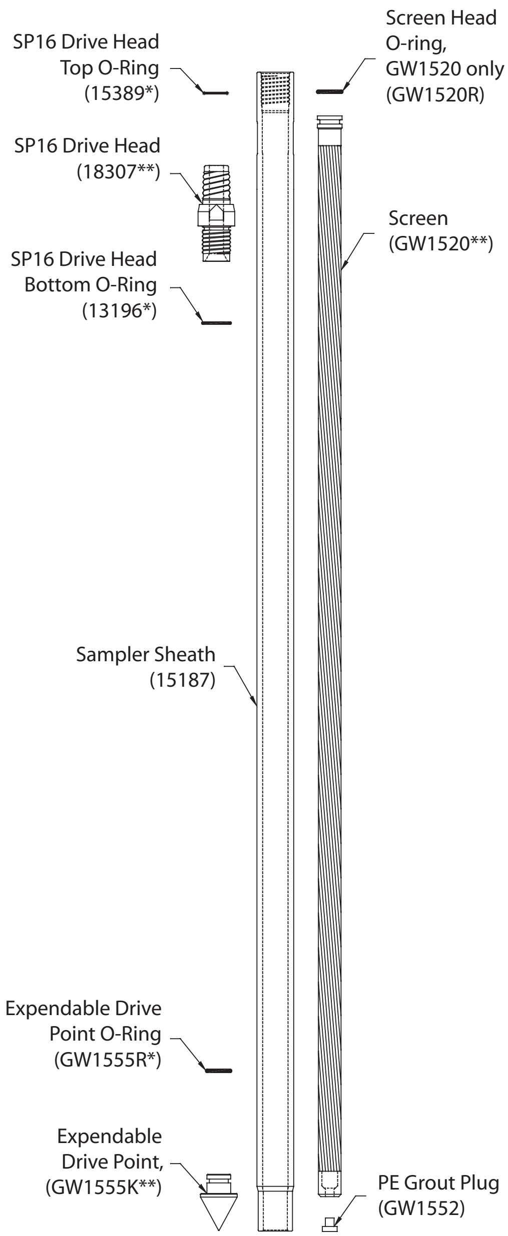
Grout Accessories	**Part Number**
Grout Nozzle, for 0.375-inch OD tubing	GW1545
High-Pressure Nylon Tubing, 0.375-inch OD / 0.25-inch ID, 100-ft. (30 m)	11633
Grout Machine, self-contained*	GS1000
Grout System Accessories Package, 1.5-inch rods	GS1015

Groundwater Purging and Sampling Accessories	**Part Number**
Polyethylene Tubing, 0.375-inch OD, 500 ft.*	TB25L
Check Valve Assembly, 0.375-inch OD Tubing*	GW4210
Water Level Meter, 0.438-inch OD Probe, 100 ft. cable*	GW2000
Mechanical Bladder Pump**	MB470
Mini Bailer Assembly, stainless steel	GW41

Additional Tools	**Part Number**
Adjustable Wrench, 6.0-inch	FA200
Adjustable Wrench, 10.0-inch	FA201
Pipe Wrenches	NA

* See Appendix A for additional tooling options.

** Refer to the Standard Operating Procedure (SOP) for the Mechanical Bladder Pump (Technical Bulletin No. MK3013) for additional tooling needs.



* Included in the SP16 O-ring Service Kit (15844)
** Part numbers show most common tool configuration. See Appendix A for alternative parts.

FIGURE 3.1
SP16 Sampler Parts

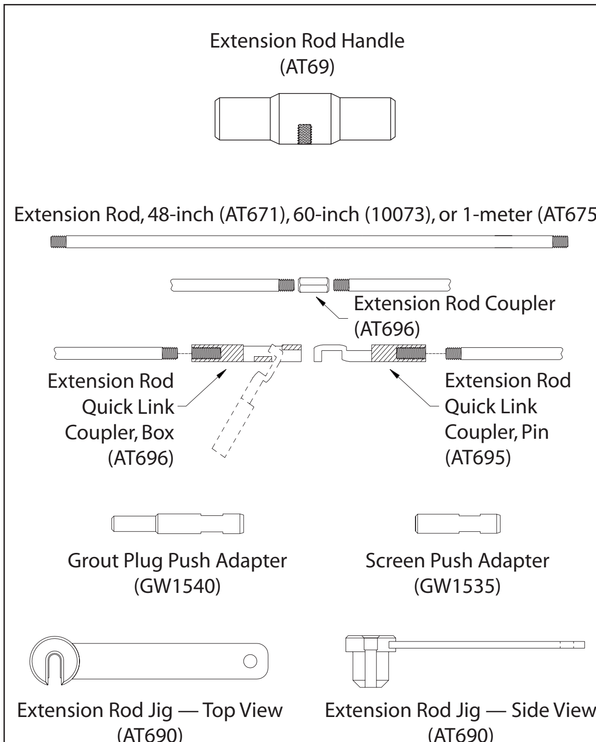


FIGURE 3.2
Geoprobe® Extension Rods and Accessories

4.0 OPERATION

4.1 Basic Operation

The SP16 sampler utilize a stainless steel or PVC screen which is encased in an alloy steel sampler sheath. An expendable drive point is placed in the lower end of the sheath while a drive head is attached to the top. O-rings on the drive head and expendable point provide a watertight sheath which keeps contaminants out of the system as the sampler is driven to depth.

Once the sampling interval is reached, extension rods equipped with a screen push adapter are inserted down the ID of the probe rods. The tool string is then retracted up to 44 inches (1118 mm) while the screen is held in place with the extension rods. The system is now ready for groundwater sampling. When sampling is complete, a removable plug in the bottom of the screen allows for grouting below the sampler as the tool string is retrieved.

4.2 Sampler Options

The Screen Point 15 and Screen Point 16 Groundwater Samplers are nearly identical. Subtle differences in the design of the SP16 sampler make it more durable than the earlier SP15 system. Operators of GH60-equipped machines should always utilize SP16 tooling. Operators of machines equipped with GH40 Series hammers may also choose SP16 tooling when sampling in difficult probing conditions.

A 1.75-inch OD Expendable Drive Point (17066K) and Disposable PVC Screen (16089) provide two useful options for the SP16 sampler. The 1.75-inch drive point may be used when soil conditions make it difficult to remove the sampler after driving to depth. The disposable PVC screen may be left downhole after sampling (when regulations permit) to eliminate the time required for screen decontamination.

4.3 Decontamination

In order to collect representative groundwater samples, all sampler parts must be thoroughly cleaned before and after each use. Scrub all metal parts using a stiff brush and a nonphosphate soap solution. Steam cleaning may be substituted for hand-washing if available. Rinse with distilled water and allow to air-dry before assembly.

4.4 SP16 Sampler Assembly (Figure 4.1)

Part numbers are listed for a standard SP16 sampler using 1.5-inch probe rods. Refer to Page 6 for screen and drive head alternatives.

1. Place an O-ring on a steel expendable drive point (GW1555K). Firmly seat the expendable point in the necked end of a sampler sheath (15187).

2. Install a PE Grout Plug (GW1552) in the bottom end of a Wire-wound Stainless Steel Screen (GW1520). Place a GW1520R O-ring in the groove on the top end of the screen.

3. Slide the screen inside of the sampler sheath with the grout plug toward the bottom of the sampler. Ensure that the expendable point was not displaced by the screen.

4. Install a bottom O-ring (13196) on a Drive Head (18307 or 15188). Thread the drive head into the sampler sheath using an adjustable wrench if necessary to ensure complete engagement of the threads. Attach a Drive Cap (12787 or 15590) to the top of the drive head.

NOTE: The 18307 drive head should be used whenever possible as the smaller 0.5-inch ID provides a greater material cross-section for increased durability.

Sampler assembly is complete.

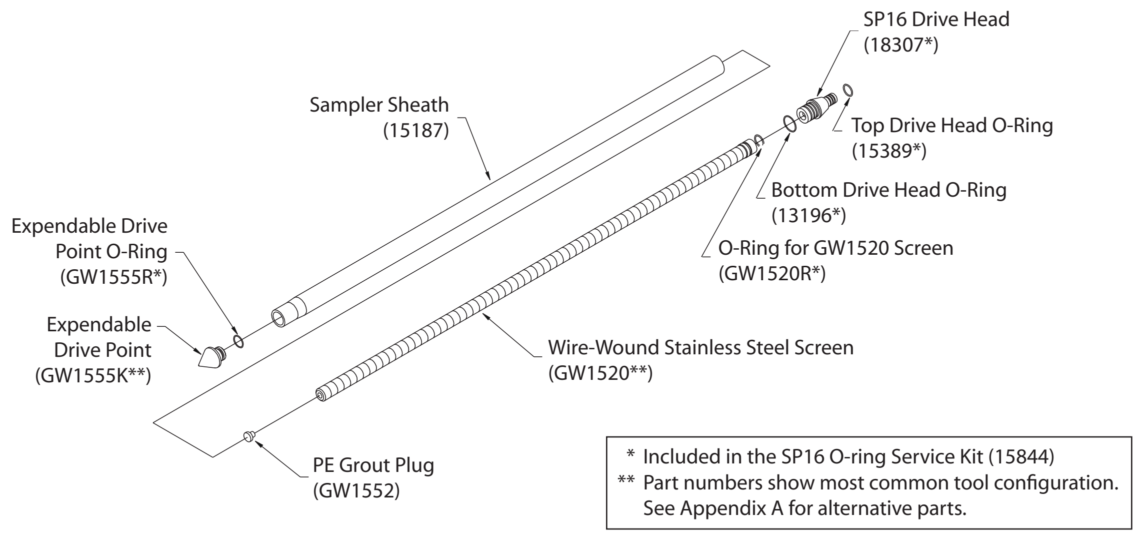


FIGURE 4.1
Screen Point 16 Groundwater Sampler Assembly

4.5 Advancing the SP16 Sampler

To provide adequate room for screen deployment with the Rod Grip Pull System, the probe derrick should be extended a little over halfway out of the carrier vehicle when positioning for operation.

1. Begin by placing the assembled sampler (Fig. 2.1.A) in the driving position beneath the hydraulic hammer of the direct push machine as shown in Figure 4.2.

2. Advance the sampler with the throttle control at slow speed for the first few feet to ensure that the sampler is aligned properly. Switch to fast speed for the remainder of the probe stroke.

3. Completely raise the hammer assembly. Remove the drive cap and place an O-ring in the top groove of the drive head. Distilled water may be used to lubricate the O-ring if needed.

Add a probe rod (length to be determined by operator) and reattach the drive cap to the rod string. Drive the sampler the entire length of the new rod with the throttle control at fast speed.

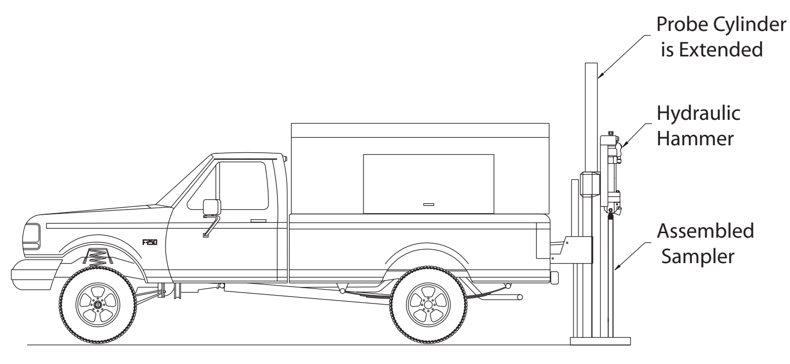


FIGURE 4.2
Screen Point 16 Groundwater Sampler in Driving Position

4. Repeat Step 3 until the desired sampling interval is reached. Approximately 12 inches (305 mm) of the last probe rod must extend above the ground surface to allow attachment of the puller assembly. A 12-inch (305 mm) rod may be added if the tool string is over-driven.

5. Remove the drive cap and retract the probe derrick away from the tool string.

4.6 Screen Deployment

1. Thread a screen push adapter (GW1535) on an extension rod of suitable length (AT671, 10073, or AT675). Attach a threaded coupler (AT68) to the other end of the extension rod. Lower the extension rod inside of the probe rod taking care not to drop it down the tool string. An extension rod jig (AT690) may be used to hold the rods.

2. Add extension rods until the adapter contacts the bottom of the screen. To speed up this step, it is recommended that Extension Rod Quick Links (AT695 and AT696) are used at every other rod joint.

3. Ensure that at least 48 inches (1219 mm) of extension rod protrudes from the probe rod. Thread an extension rod handle (AT69) on the top extension rod.

4. Maneuver the probe assembly into position for pulling.

5. Raise (pull) the tool string while physically holding the screen in place with the extension rods (Fig. 4.3.B). A slight knock with the extension rod string will help to dislodge the expendable point and start the screen moving inside the sheath.

Raise the hammer and tool string about 44 inches (1118 cm) if using a GW1520 or GW1530 screen. At this point the screen head will contact the necked portion of the sampler sheath (Fig. 4.3.C.) and the extension rods will rise with the probe rods. Use care when deploying a PVC screen so as not to break the screen when it contacts the bottom of the sampler sheath.

The Disposable Screen (16089) will extend completely out of the sheath if the tool string is raised more than 45 inches (1143 mm). Measure and mark this distance on the top extension rod to avoid losing the screen during deployment.

6. Remove the rod grip handle, lower the hammer assembly, and retract the probe derrick. Remove the top extension rod (with handle) and top probe rod. Finally, extract all extension rods.

7. Groundwater samples can now be collected with a mini-bailer, peristaltic or vacuum pump, tubing bottom check valve assembly, bladder pump, or other acceptable small diameter sampling device.

When inserting tubing or a bladder pump down the rod string, ensure that it enters the screen interval. The leading end of the tubing or bladder pump will sometimes catch at the screen head giving the illusion that the bottom of the screen has been reached. An up-and-down motion combined with rotation helps move the tubing or bladder pump past the lip and into the screen.

4.7 Abandonment Grouting for GW1520 and GW1530 Screens

The SP16 Sampler can meet ASTM D 5299 requirements for abandoning environmental wells or borings when grouting is conducted properly. A removable grout plug makes it possible to deploy tubing through the bottom of GW1520 and GW1530 screens. A GS500 or GS1000 Grout Machine is then used to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling. Attach the rod grip puller to the top probe rod. Raise the tool string approximately 4 to 6 inches (102 to 152 cm) to allow removal of the grout plug.

2. Thread the Grout Plug Push Adapter (GW1540) onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the grout plug at the bottom of the screen. Attach the handle to the top extension rod. When the extension rods are slightly raised and lowered, a relatively soft rebound should be felt as the adapter contacts the grout plug. This is especially true when using a PVC screen.

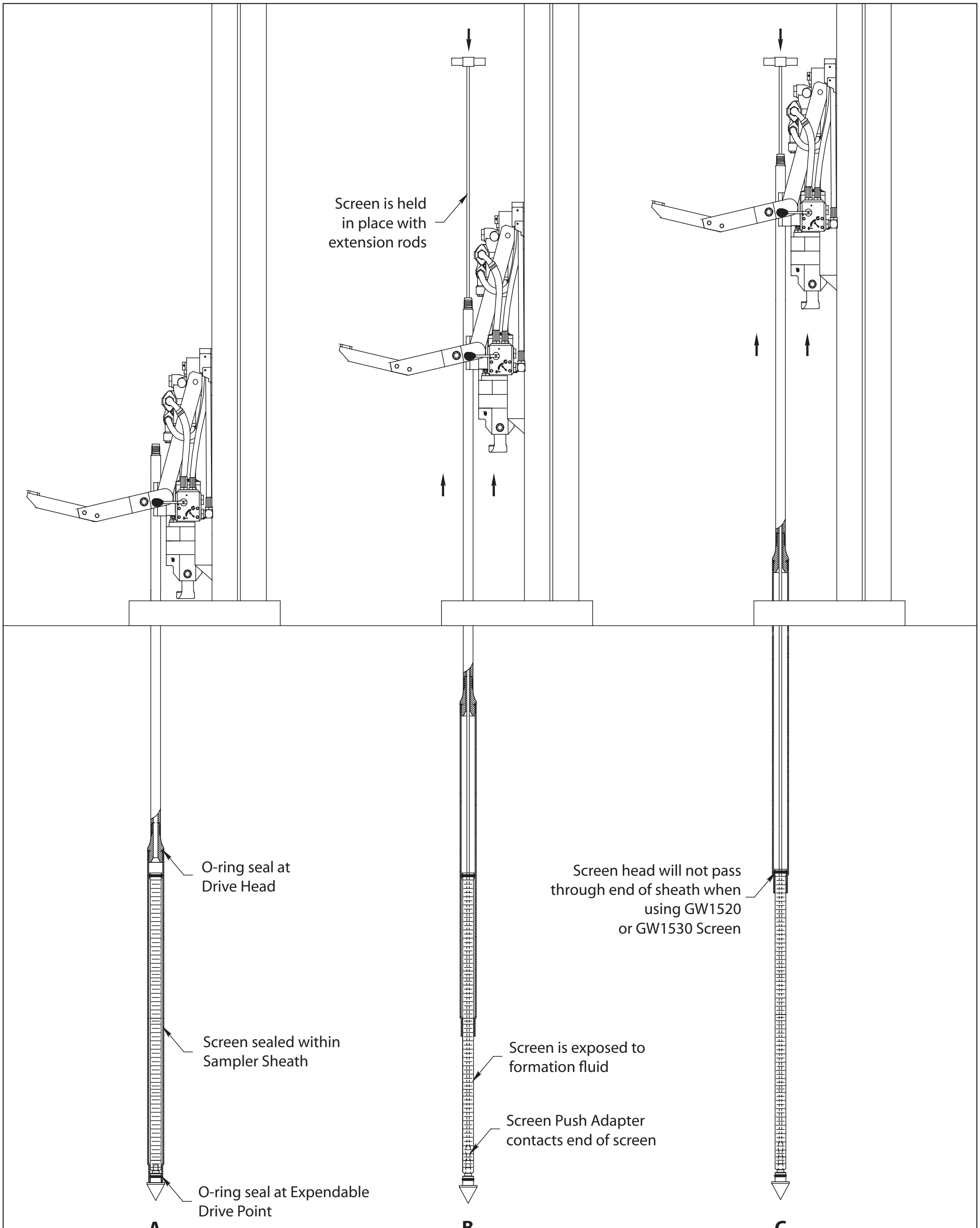


FIGURE 4.3
Screen Deployment for SP16 Sampler

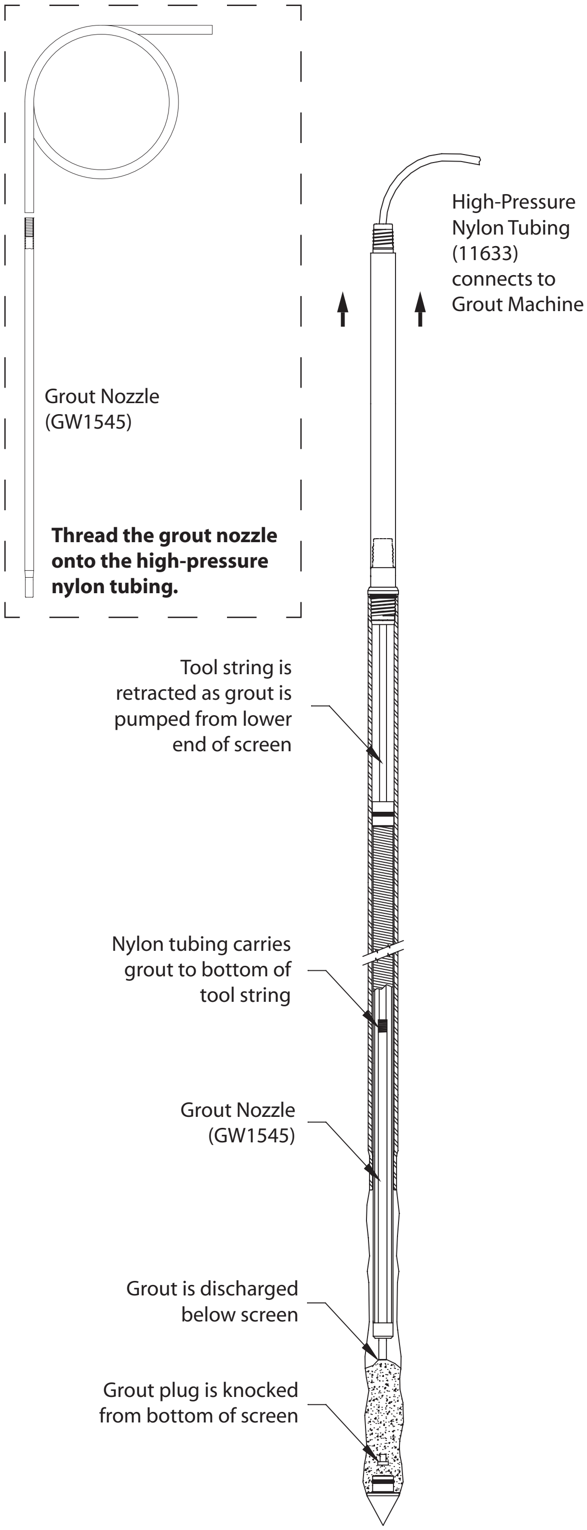


FIGURE 4.4

Grouting the SP16 Sampler With a GW1520 or GW1530 Screen

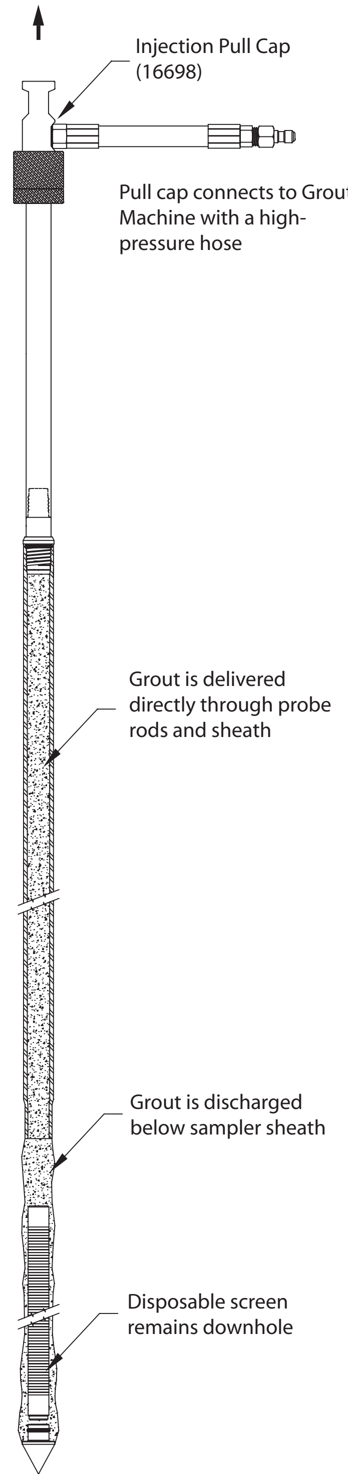


FIGURE 4.5

Grouting the SP16 Sampler With a 16089 Disposable Screen

3. Place a mark on the extension rod even with the top of the probe rod. Apply downward pressure on the extension rods and push the grout plug out of the screen. The mark placed on the extension rod should now be below the top of the probe rod. Remove all extension rods.

   Note: When working with a stainless steel screen, it may be necessary to raise and quickly lower the extension rods to jar the grout plug free. When the plug is successfully removed, a metal-on-metal sensation may be noted as the extension rods are gently "bounced" within the probe rods.

4. A Grout Nozzle (GW1545) is now connected to High-Pressure Nylon Tubing (11633) and inserted down through the probe rods to the bottom of the screen (Fig. 4.4). It may be necessary to pump a small amount of clean water through the tubing during deployment to jet out sediments that settled in the bottom of the screen. Resistance will sometimes be felt as the grout nozzle passes through the drive head. Rotate the tubing while moving it up-and-down to ensure that the nozzle has reached the bottom of the screen and is not hung up on the drive head.

   ***Note:** All probe rods remain strung on the tubing as the tool string is pulled. Provide extra tubing length to allow sufficient room to lay the rods on the ground as they are removed. An additional 20 feet is generally enough.*

5. Operate the grout pump while pulling the first rod with the rod grip pull system. Coordinate pumping and pulling rates so that grout fills the void left by the sampler. After pulling the first rod, release the rod grip handle, fully lower the hammer, and regrip the tool string. Unthread the top probe and slide it over the tubing placing it on the ground near the end of the tubing.

6. Repeat Step 5 until the sampler is retrieved. Do not bend or kink the tubing when pulling and laying out the probe rods. Sharp bends create weak spots in the tubing which may burst when pumping grout. Remember to operate the grout pump only when pulling the rod string. The probe hole is thus filled with grout from the bottom up as the rods are extracted.

7. Promptly clean all probe rods and sampler parts before the grout sets up and clogs the equipment.

4.8 Abandonment Grouting for the 16089 Disposable Screen

ASTM D 5299 requirements can also be met for the SP16 samplers when using the 16089 disposable screen. Because the screen remains downhole after sampling, the operator may choose either to deliver grout to the bottom of the tool string with nylon tubing or pump grout directly through the probe rods using an Injection Pull Cap (16698). A GS500 or GS1000 Grout Machine is needed to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling with the rod grip puller.

2. Thread the screen push adapter onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the bottom of the screen. Attach the handle to the top extension rod.

3. The disposable screen must be extended at least 46 inches (1168 mm) to clear the bottom of the sampler sheath. Considering the length of screen deployed in Section 4.7, determine the remaining distance required to fully extend the screen from the sheath. Mark this distance on the top extension rod.

4. Pull the tool string up to the mark on the top extension rod while holding the disposable screen in place.

   The screen is now fully deployed and the sampler is ready for abandonment grouting. Apply grout to the bottom of the tool string during retrieval using either flexible tubing (as described in Section 4.7) or an injection pull cap (Fig. 4.5). This section continues with a description of grouting with a pull cap.

5. Remove the rod grip handle and maneuver the probe assembly directly over the tool string. Thread an Injection Pull Cap (16698) onto the top probe rod and close the hammer pull latch over the top of the pull cap.

6. Connect the pull cap to a Geoprobe® grout machine using a high-pressure grout hose.

7. Operate the pump to fill the entire tool string with grout. When a sufficient volume has been pumped to fill the tool string, begin pulling the rods and sampler while continuing to operate the grout pump. Considering the known pump volume and sampler cross-section, time tooling withdrawal to slightly "overpump" grout into the subsurface. This will ensure that all voids are filled during sampler retrieval.

   The grouting process can lubricate the probe hole sufficiently to cause the tool string to slide back downhole when disconnected from the pull cap. Prevent this by withdrawing the tool string with the rod grip puller while maintaining a connection to the grout machine with the pull cap.

4.9 Retrieving the Screen Point 16 Sampler

If grouting is not required, the Screen Point 16 Sampler can be retrieved by pulling the probe rods as with most other Geoprobe® applications. The Rod Grip Pull System should be used for this process as it allows the operator to remove rods without completely releasing the tool string. This avoids having the probe rods fall back downhole when released during the pulling procedure. A standard Pull Cap (15164) may still be used if preferred. Refer to the Owner's Manual for your Geoprobe® direct push machine for specific instructions on pulling the tool string.

5.0 REFERENCES

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Appendix A
ALTERNATIVE PARTS

The following parts are available to meet unique soil conditions. See section 3.0 for a complete listing of the common tool configurations for the Geoprobe® Screen Point 16 Groundwater Sampler.

SP16 Sampler Parts and Accessories	Part Number
SP16 Drive Head, 0.625-inch bore, 1.5-inch rods	15188
Expendable Drive Points, aluminum, 1.625-inch OD (Pkg. of 25)	GW1555ALK
Expendable Drive Points, steel, 1.75-inch OD (Pkg. of 25)	17066K
Screen, PVC, 10-Slot	GW1530
Screen, Disposable, PVC, 10-Slot	16089

Groundwater Purging and Sampling Accessories	Part Number
Polyethylene Tubing, 0.25-inch OD, 500 ft.	TB17L
Polyethylene Tubing, 0.5-inch OD, 500 ft.	TB37L
Polyethylene Tubing, 0.625-inch OD, 50 ft.	TB50L
Check Valve Assembly, 0.25-inch OD Tubing	GW4240
Check Valve Assembly, 0.5-inch OD Tubing	GW4220
Check Valve Assembly, 0.625-inch OD Tubing	GW4230
Water Level Meter, 0.375-inch OD Probe, 100-ft. cable	GW2001
Water Level Meter, 0.438-inch OD Probe, 200-ft. cable	GW2002
Water Level Meter, 0.375-inch OD Probe, 200-ft. cable	GW2003
Water Level Meter, 0.438-inch OD Probe, 30-m cable	GW2005
Water Level Meter, 0.438-inch OD Probe, 60-m cable	GW2007
Water Level Meter, 0.375-inch OD Probe, 60-m cable	GE2008

Grouting Accessories	Part Number
Grout Machine, auxiliary-powered	GS500

Probe Rods, Extension Rods, and Accessories	Part Number
Probe Rod, 1.5-inch x 1-meter	17899
Probe Rod, 1.5-inch x 48-inch	13359
Drive Cap, 1.5-inch rods (for GH40 Series Hammer)	15590
Rod Grip Pull Handle, 1.5-inch Probe Rods (for GH40 Series Hammer)	GH1555
Extension Rod, 48-inch	AT671
Extension Rod, 1-meter	AT675

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems®.

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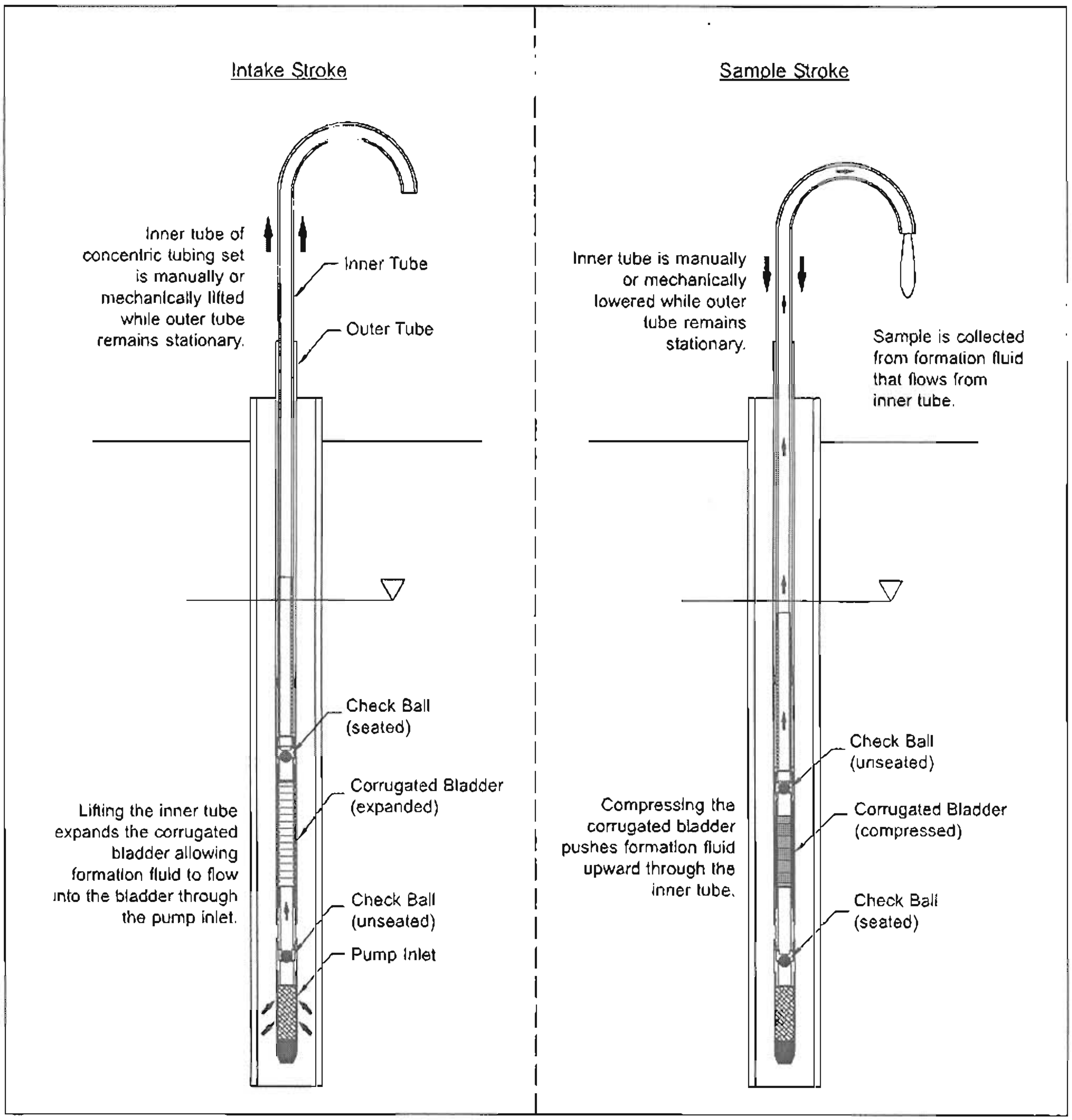
Geoprobe® Model MB470 Mechanical Bladder Pump

Standard Operating Procedure

Technical Bulletin No. MK3013

PREPARED: November, 2003
REVISED: July, 2006



INTAKE AND SAMPLE STROKES OF THE MB470 MECHANICAL BLADDER PUMP

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The Mechanical Bladder Pump is manufactured under
U.S. Patent No. 6,877,965 issued April 12, 2005.

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1.0 OBJECTIVE

The objective of this document is to provide guidance on how to collect a representative sample of the subsurface formation fluid utilizing the Geoprobe® Model MB470 Mechanical Bladder Pump.

2.0 BACKGROUND

2.1 Definitions

Geoprobe®*: A brand name of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and testing, soil conductivity and contaminant logging, grouting, and materials injection.
**Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

MB470 Mechanical Bladder Pump** (MBP): A device for obtaining high-quality, low-turbidity samples from groundwater monitoring wells and direct push installed groundwater samplers as small as .5 inches (13 mm) inside diameter (ID). The MBP may be used to meet requirements of the low-flow sampling protocol (Puls and Barcelona 1996, ASTM 2003). Through participation in a U.S. EPA Environmental Technology Verification study, it was confirmed that the MB470 can provide representative samples (EPA 2003).
***The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

Within the MB470 pump body, a corrugated Teflon® fluorinated ethylene propylene (FEP) bladder is mechanically compressed and expanded to push groundwater to the surface through a concentric tubing set. Check valves above and below the bladder control flow direction. The outer tube of the concentric tubing set holds the pump body in place while the inner tube is used to actuate the bladder and transmit water to the surface. The pump body and internal components are made of stainless steel with an outside diameter (OD) of .47 inches (12 mm) and an overall length of 26.75 inches (679 mm) with an inlet screen assembly installed.

2.2 MBP System Components

The three basic components of the Model MB470 Mechanical Bladder Pump system are the pump, concentric tubing set, and actuator.

Pump

All pump components (Fig. 2.1) are made of stainless steel material with the exception of the three fluorosilicone O-rings and the Teflon® bladder.

Beginning at the downhole end of the pump, either a Bullet Nose Intake (P/N 20675) or Inlet Screen Assembly (P/N 20725) may be used as determined by project requirements. The screen assembly includes a 60 mesh wire screen with an actual screen length of 6 inches (152 mm). The bullet nose intake is open at the leading end and provides no filtering effect.

Above the intake/inlet, the pump body contains the corrugated bladder and check balls that physically move groundwater to the surface for purging and sampling. As the top of the bladder is extended, the expanding action of the bladder draws groundwater into the bladder through the intake/inlet. Compressing the bladder then pushes the groundwater up through the connected inner tube of the concentric tubing set. Check balls at the Upper and Lower Bladder Adapters (P/N 20679 and 20677) control groundwater flow through the bladder.

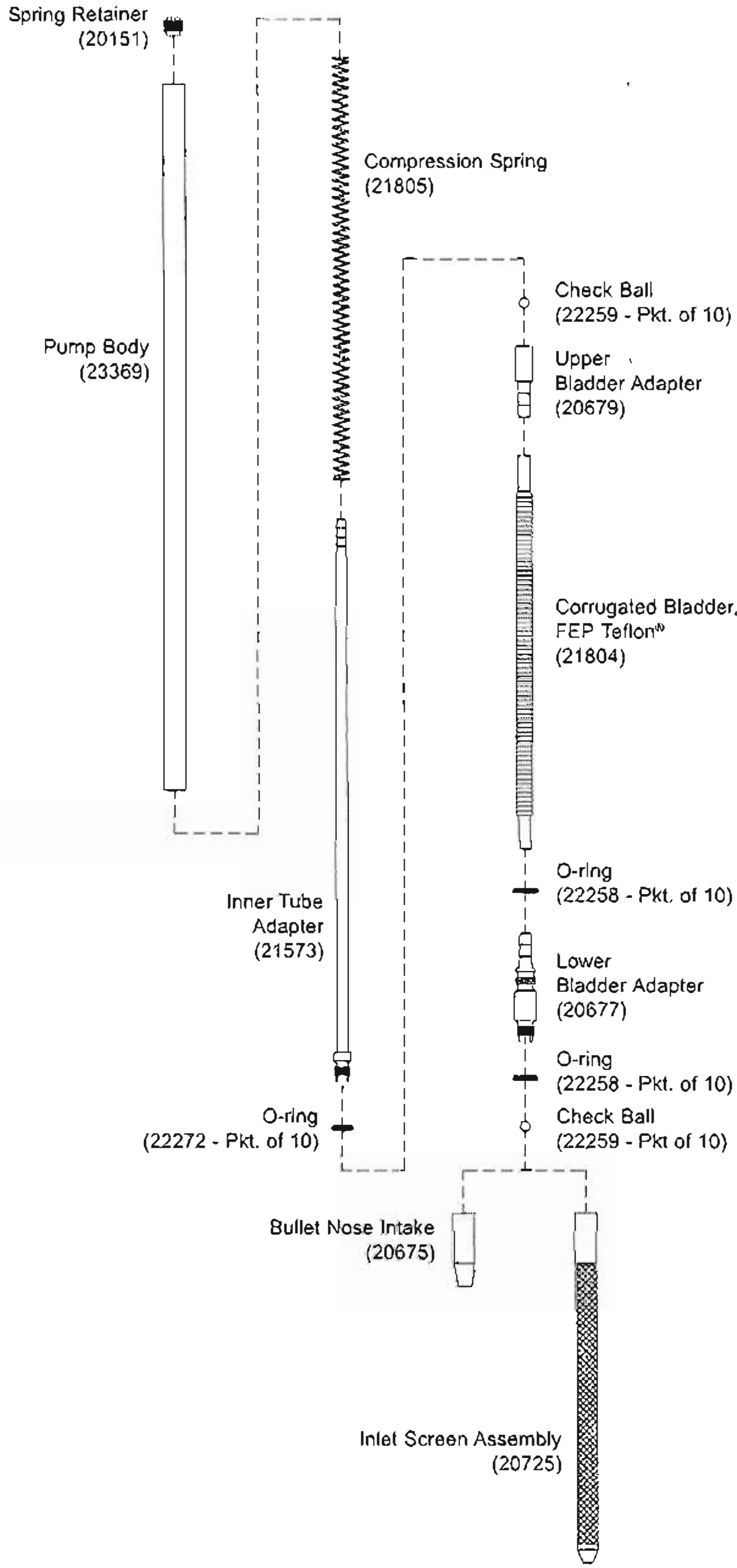


Figure 2.1: Components of MB470 Pump.

The lower end of the corrugated bladder is secured to the pump body by the Lower Bladder Adapter (P/N 20677). The top of the bladder is attached to the inner tube of the concentric tubing set by the Upper Bladder Adapter (P/N 20679) and Inner Tube Adapter (P/N 21573). During operation of the pump, the inner tube is raised and lowered to expand and contract the bladder to move formation fluid to ground surface.

Concentric Tubing Set

A concentric tubing set for the MB470 Mechanical Bladder Pump commonly consists of .19-inch (5 mm) ID / .25-inch (6 mm) OD Teflon® fluorinated ethylene propylene (FEP) tubing surrounded by .31-inch (8 mm) ID / .44-inch (11 mm) OD high-density polyethylene (HDPE) tubing. Where allowed by project requirements, other materials (e.g. low-density polyethylene (LDPE) tubing) may be utilized in place of the Teflon® inner tubing.

Available lengths for the concentric tubing set are 50 and 100 feet (15.2 and 30.5 m). Custom lengths may be assembled from 500-foot rolls of appropriate tubing sizes and materials, some of which are listed on Page 6.

Refer to the magnified view in Figure 2.2. The inner tube of the concentric tubing set is attached to the Inner Tube Adapter (P/N 21573) during assembly of the MB470 pump. The outer tube is then threaded inside the top end of the pump body. Once lowered down the sampler or monitoring well, the outer tube is held stationary either manually or by attachment to a mechanical actuator. The inner tube is raised and lowered by hand or through use of the mechanical actuator to expand and compress the pump bladder. Formation fluid is thus drawn into the pump bladder and then pushed to ground surface.

Actuator

Actuators provide the physical means of holding the outer tube of the concentric tubing set stationary while cycling the inner tube up-and-down. Actuator kits are available for manually or mechanically powering the MB470 pump.

For the manual actuator shown in Figure 2.2, the outer tube of the concentric tubing set is attached to the probe rods using two adapters. The inner tubing is raised and lowered by hand to obtain the groundwater sample. Refer to Section 4.4 for more actuator options.

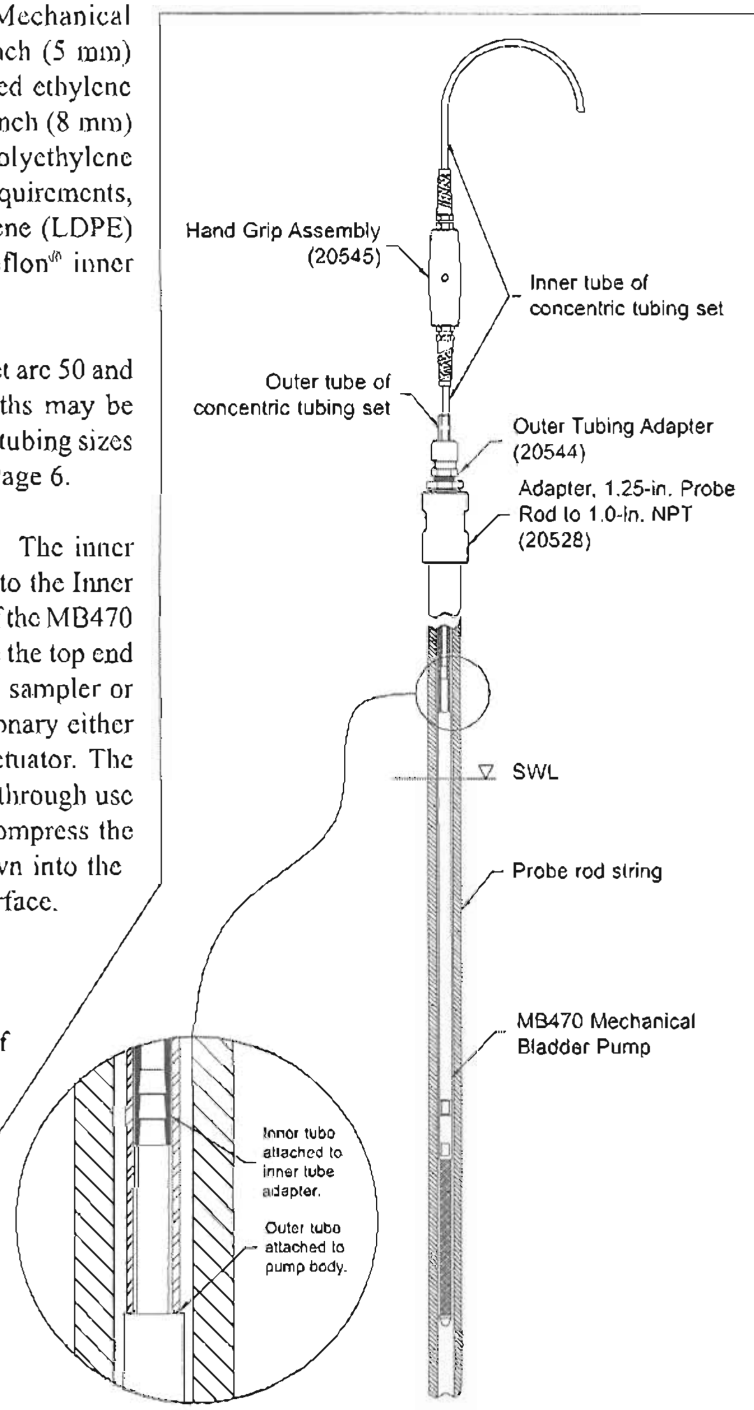


Figure 2.2: MB470 Mechanical Bladder Pump and manual actuator as used in a direct push installed groundwater sampler.

3.0 REQUIRED EQUIPMENT

The following equipment is required to collect representative groundwater samples using the Model MB470 Mechanical Bladder Pump. Refer to Figure 3.1 for identification of the specified parts.

Pump Components	Quantity	Part Number
Mechanical Bladder Pump	-1-	MB470
Service Parts Kit, for MB470 Pump	-1-	MB7500
Includes: O-ring Pick	-1-	AT102
Corrugated Bladder, Teflon* FEP	-3-	21804
Compression Spring, Stainless Steel (SS)	-1-	21805
O-rings for Lower Bladder Adapter (#5-585 Fluorosilicone), Pkg. of 10	-1-	22258
O-rings for Inner Tube Adapter (#010 Fluorosilicone), Pkg. of 10	-1-	22272
Check Balls (7/32-in. diameter), SS, Pkg. of 10	-1-	22259
MBP Assembly Tool	-1-	20456
MBP Cleaning Brush Kit	-1-	MB7300
MBP Assembly Tool	-1-	20456

Tubing Options	Quantity	Part Number
Concentric Tubing Set, HDPE (outer)/FEP (inner), .44-in. OD x 50-ft. length	Variable	MB5050
Concentric Tubing Set, HDPE/FEP, .44-in. OD - 100-ft. length	Variable	MB5100
Concentric Tubing Set, HDPE/LDPE, .44-in. OD - 50-ft. length	Variable	MB5051
Concentric Tubing Set, HDPE/LDPE, .44-in. OD - 100-ft. length	Variable	MB5101
Concentric Tubing Set, HDPE/PP, .44-in. OD - 50-ft. length	Variable	MB5052
Concentric Tubing Set, HDPE/PP, .44-in. OD - 100-ft. length	Variable	MB5102
LDPE Tubing, .19-in. ID x .25-in. OD - 100-ft. length	Variable	TB171L
LDPE Tubing, .19-in. ID x .25-in. OD - 500-ft. length	Variable	TB17L
Teflon* FEP Tubing, .19-in. ID x .25-in. OD - 50-ft. length	Variable	TB17T
Teflon* FEP Tubing, .19-in. ID x .25-in. OD - 100-ft. length	Variable	TB171T
Teflon* FEP Tubing, .19-in. ID x .25-in. OD - 500-ft. length	Variable	TB175T
PP Tubing, .17-in. ID x .25-in. OD - 50-ft. length	Variable	TB17P
PP Tubing, .17-in. ID x .25-in. OD - 100-ft. length	Variable	TB171P
HDPE Tubing, .31-in. ID x .44-in. OD - 50-ft. length	Variable	TB31H
HDPE Tubing, .31-in. ID x .44-in. OD - 100-ft. length	Variable	TB311H
HDPE Tubing, .31-in. ID x .44-in. OD - 500-ft. length	Variable	TB315H

Actuator Options	Quantity	Part Number
Manual Actuator Kit	-1-	MB7000
Includes: Hand Grip Assembly	-1-	20545
Outer Tubing Grip	-1-	22758
Outer Tubing Adapter	-1-	20544
Mechanical Actuator Assembly	-1-	MB6000
Electric Actuator Assembly, 12VDC	-1-	MB6120
Electric Actuator Kit, 12VDC	-1	MB6120K
Well Mount Kit (for use with MB6000)	-1-	MB7200

Adapters for Use with Actuators	Quantity	Part Number
MBP PVC Riser Adapter Kit	-1-	MB7100
Includes: PVC Extension, 1.0-in. NPT Pin x 1.0-in. NPT Pin - 12-in. Length	-1-	17560
PVC Coupling, 1.0-in. NPT Box x 1.0-in. NPT Box	-1-	21145
Adapter, 2.0-in. PVC to 1.0-in. NPT Pin	-1-	22759
O-rings for 2.0-in. PVC to 1.0-in. NPT Pin Adapter, pkg. of 25	-1-	22313
Adapter, 1.0-in. PVC to 1.0-in. NPT Pin	-1-	17558
O-rings for 1.0-in. PVC to 1.0-in. NPT Pin Adapter, pkg. of 25	-1-	13942
Adapter, 0.75-in. PVC to 17558 Adapter (0.75-in. PVC requires 2 adapters)	-1-	19424
O-rings for 0.75-in. PVC to 17558 Adapter, pkg. of 25	-1-	13196
Adapter, 0.5-in. PVC to 17558 Adapter (0.5-in. PVC requires 2 adapters)	-1-	17559
O-rings for 0.5-in. PVC to 17558 Adapter, pkg. of 25	-1-	GW1555R
Adapter, Geoprobe* 1.0-in. Probe Rod Pin to 1.0-in. NPT Pin	-1-	20527
Adapter, Geoprobe* 1.25-in. Probe Rod Pin to 1.0-in. NPT Pin	-1-	20528
Adapter, Geoprobe* 1.5-in. Probe Rod Pin to 1.0-in. NPT Pin	-1-	20529

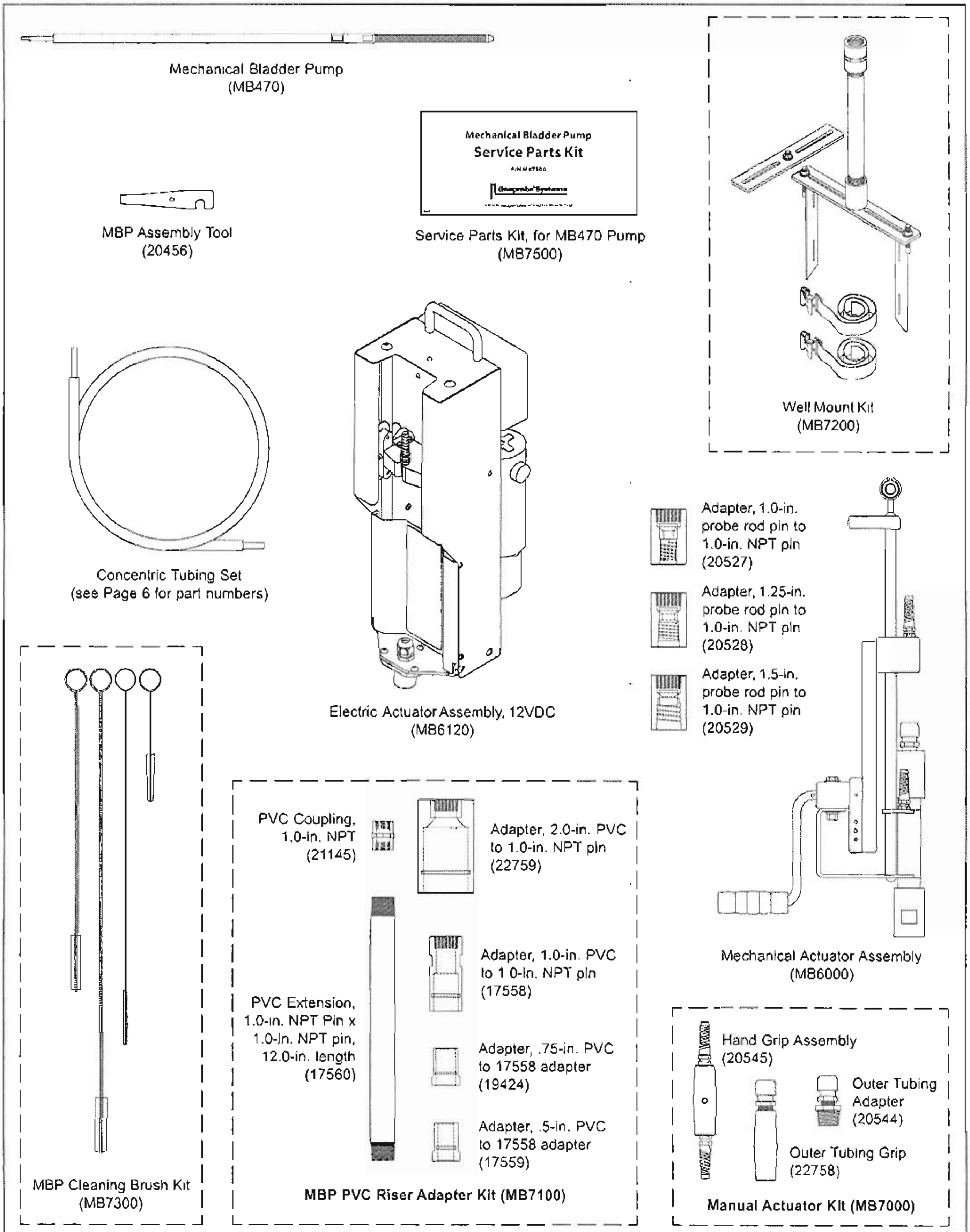


Figure 3.1: MB470 Mechanical Bladder Pump parts and accessories.

4.0 OPERATION

Use and operation of the MB470 Mechanical Bladder Pump may be divided into five main steps:

- *Assembling the Pump*
- *Selecting and installing the concentric tubing set*
- *Selecting and installing the actuator*
- *Purging and sampling*
- *Decontaminating the Pump*

4.1 Assembling the Pump

This section identifies the procedures for assembling the components of the MB470 Mechanical Bladder Pump and performing a leak check on the corrugated bladder. Refer to Figure 4.1 for parts identification.

1. Ensure that all metal parts are clean and free of burrs that may damage the pump threads or the corrugated bladder during assembly.

2. Install two fluorosilicone O-rings (22258) on the Lower Bladder Adapter (20677). Note that these are the larger of the two sizes of O-rings used with the MB470 pump.

3. Lubricate the O-ring of the lower bladder adapter and inside the Bullet Nose Intake (20675) with DI water. Place a Check Ball (22259) in the bullet nose intake and thread the intake onto the lower bladder adapter.

NOTE: The bullet nose intake is used here to make it easier to leak check the pump later in this procedure. After the leak check has been performed, the bullet nose intake may be replaced with a Screen Inlet Assembly (20725) if desired.

4. Install a fluorosilicone O-ring (22272) on the lower end of the Inner Tube Adapter (21573). Note that this is the smaller of the two sizes of O-rings used with the MB470 pump.

5. Lubricate the O-ring of the inner tube adapter and inside the Upper Bladder Adapter (20679) with DI water. Thread the upper bladder adapter onto the inner tube adapter.

NOTE: A check ball must be installed in the upper bladder adapter after performing the leak check in Step 7.

6. Install the Teflon® FEP Corrugated Bladder (21804):

   - The bladder should be installed with the corrugations pointing "up" (toward the upper bladder adapter/inner tube adapter) as indicated in Figure 4.2.
   - Firmly push and rotate the lower cuff of the bladder over the barbed end of the lower bladder adapter.
   - Firmly push and rotate the upper cuff of the bladder over the barbed end of the upper bladder adapter.
   - Both ends of the bladder should be fully seated on the adapter barbs.

CAUTION: Although firmness is required during installation of the bladder, avoid crushing, kinking, or twisting the bladder corrugations to prevent damage.

7. Perform a leak check on the corrugated bladder before fully assembling the pump components to ensure that the bladder is free of defects. (Leak check procedure is given on opposite page.)

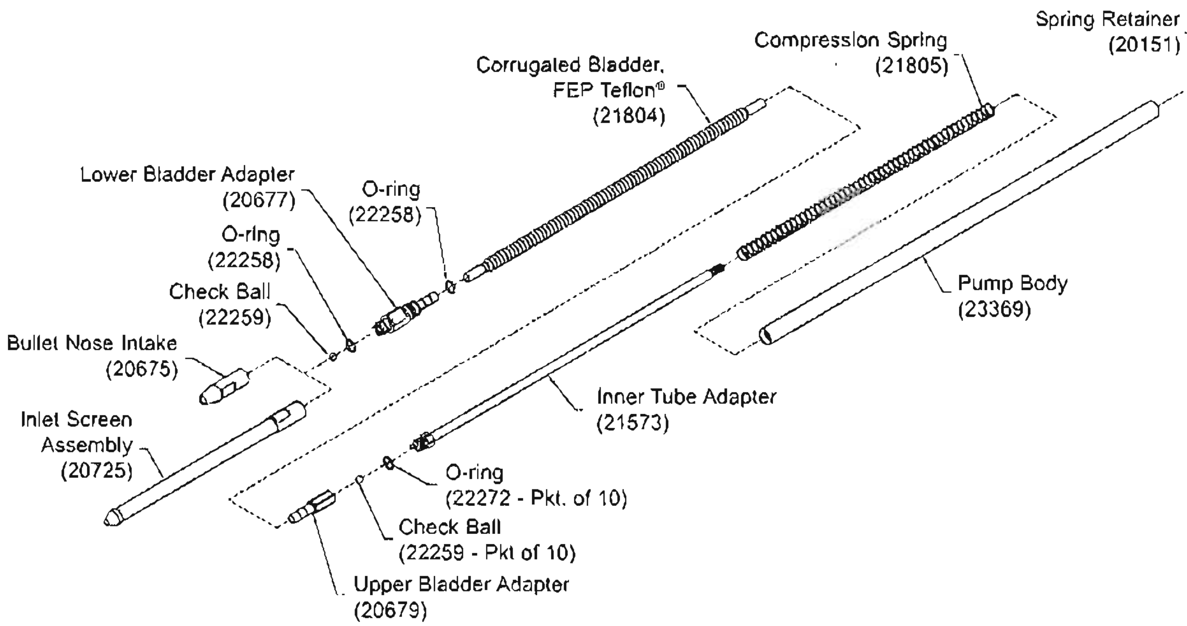


Figure 4.1: Isometric exploded view of the MB470 Mechanical Bladder Pump.

Leak check the corrugated bladder as follows:

- Completely submerge the bladder and lower end of the inner tube adapter in a clean beaker or small bucket of distilled or DI water.
- Firmly blow into the open end of the inner tube adapter. Leaks in the bladder or assembled parts will be indicated by bubbles.
- If leaks are found, replace the faulty O-ring(s) or bladder. Retest to ensure that all leakage has stopped.
- Once the pump has passed the leak test, unthread the upper bladder adapter from the inner tube adapter. Place a Check Ball (22259) in the upper bladder adapter and reinstall it in the inner tube adapter.
- Replace the bullet nose intake with an Inlet Screen Assembly (20725) if desired. Remember to include the check ball when installing the inlet screen.

8. The Pump Body (23369) is internally threaded at each end. Threads run all the way to the end of the pump body at the upper end, but stop .25 inches (6 mm) from the end at the lower end of the pump body to permit an O-ring seal.

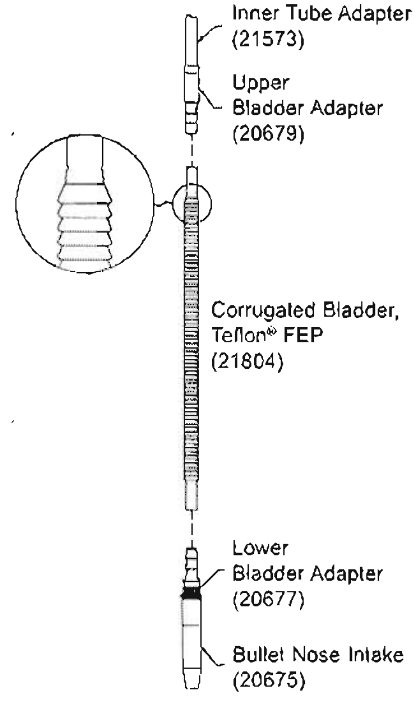


Figure 4.2: Bladder corrugations should point "up".

Thread the Spring Retainer (20151) into the top of the pump body. Install the retainer with the slotted end out to allow use of a medium slotted screw driver or the MBP Assembly Tool (20456) to thread or unthread the retainer.

9. Place the Compression Spring (21805) over the top of the inner tube adapter. Slide the spring completely onto the adapter until it contacts the hex fitting.

10. Slide the lower end of the pump body over the top of the inner tube adapter and pump spring. The inner tube adapter will slip through the spring retainer and extend approximately 3 inches (75 mm) from the top of the pump body.

11. The lower bladder adapter is now threaded into the pump body to complete the assembly process.

    - Lubricate the O-ring on the lower bladder adapter and inside the lower end of the pump body with DI water.
    - Grasp the pump body with one hand and the lower bladder adapter with the other hand.
    - Gently compress the spring and bladder into the pump body.
    - Thread the lower bladder adapter into the pump body. Use care to avoid cutting or pinching the O-ring while threading the parts together. The O-ring will no longer be visible when the adapter is fully seated.

Assembly of the MB470 Mechanical Bladder Pump is now complete.

4.2 Selecting and Installing the Concentric Tubing Set

Selecting the Concentric Tubing Material and Length

The outer tube of the concentric tubing set commonly consists of .44-inch OD x .31-inch ID (11.2 mm x 7.9 mm) HDPE material. Inner tube material options are Teflon® FEP, LDPE, or PP. Teflon® FEP and LDPE tubing have dimensions of .25-inch OD x .19-inch ID (6.4 mm x 4.8 mm) while the PP tubing measures .25-inch OD x .17-inch ID (6.4 mm x 4.3 mm).

LDPE inner tubes are the least expensive option. The elasticity of this material may be excessive for deeper wells and in warm ambient conditions (summertime). Teflon® FEP inner tubes are less elastic and provide higher sample quality compared to LDPE due to the chemical properties of the two materials. Teflon® FEP also has a lower coefficient of friction for smoother actuation of the bladder and less resistance to operation, especially at greater depths. The main drawback of Teflon® FEP is its higher cost. PP inner tubes provide a compromise between LDPE and Teflon® FEP in that they are less elastic and provide higher sample quality than LDPE at a lower cost than Teflon® FEP.

While Teflon® FEP exhibits relatively good chemical inertness, it will absorb and desorb some volatile organic contaminants (Parker & Ranney 1998). Because of this, ambient groundwater should be purged through the pump and tubing system for a period of time to achieve equilibrium between the bladder and tubing and sample fluid. The period of time may vary for different volatile organic compounds (VOCs), but if low flow sampling (Puls and Barcelona 1996, ASTM 2003) is conducted, chemical equilibrium may be achieved by the time the monitored water quality parameters (DO, ORP, turbidity, etc.) have stabilized.

Preassembled concentric tubing sets are available from Geoprobe Systems® in lengths of 50 and 100 feet (15.2 and 30.5 m). The user may choose to assemble sets of custom lengths from separate rolls of inner and outer tubing in preparation for the sampling event or while on-site. Be careful to keep the tubing clean while inserting the inner tube into the outer tube.

When long tubing sets are required, it may be wise to use clean PVC riser pipe to protect the tubing during assembly. Simply thread PVC riser sections together, placing them on the shop floor or along the ground surface. Cap one end of the casing to keep dirt and debris out during assembly. Determine the length of the outer tube required and make the PVC casing about the same length. Slide the outer tube into the PVC casing and cut to the desired length. Slide the inner tube into the outer tube. Cut the inner tube three or more feet longer than the outer tube to complete the concentric tubing set.

Keep all tubing stored in clean airtight bags or containers so that dirt, dust, and cross contamination are not a concern or problem. No matter how clean the pump is, sample quality will suffer if the tubing is dirty. Be sure the tubing is of clean, quality material and is not marked with inks that may contribute to cross contamination.

Installing the Concentric Tubing Set on the MB470 Pump

The concentric tubing set is attached to the mechanical bladder pump by pushing the inner tube onto the hose barb on the end of the inner tube adapter and then threading the outer tube into the pump body.

1. Push the inner tube of the concentric tubing set onto the hose barb on the end of the inner tube adapter (Fig. 4.3). Fully seat the tube on the adapter such that the tube engages all three barbs. Take care not to kink or otherwise damage the tubing.

2. Before installing the outer tube, unthread the lower bladder adapter from the pump body and lay the partially disassembled pump on a clean, level surface. This step is recommended so that the bladder is not twisted or damaged as the outer tubing is installed.

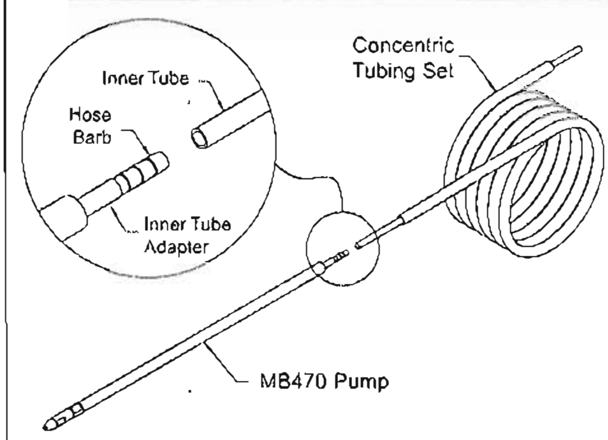


Figure 4.3: Fully seat the inner tube onto the hose barbs of the inner tube adapter.

3. Push and thread the outer tube into the top end of the pump body (Fig. 4.4). The outer tube should be threaded about 0.75 inches (19 mm) into the pump body until it butts against the spring retainer. Remember to take care not to kink or otherwise damage the tubing during installation.

4. Rotate the lower bladder adapter counterclockwise one or two revolutions to minimize torque on the bladder when threading the adapter into the pump body. Now reinstall the lower bladder adapter and inner tube adapter into the lower end of the pump body.

   The pump and tubing set are now assembled and ready for installation into the monitoring well or sampler.

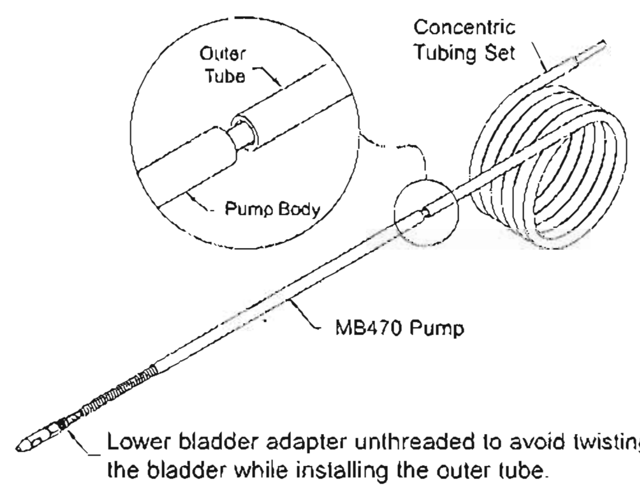


Figure 4.4: Thread the outer tube of the concentric tubing set into the pump body.

NOTE: Friction between the inner and outer tubes may make it difficult to attach the pump with the tubing set coiled. To overcome this problem, attach the pump while the concentric tubing is unrolled in the PVC riser sections as described at the bottom of Page 10.

The user may also choose to lower the concentric tubing set partway down the tool string or well, attach the pump to the exposed end of the tubing, retrieve the tubing set, and install the pump for purging or sampling. If this technique is used, **take great care to avoid dropping the tubing set down the well or tool string during attachment of the pump.**

4.3 Selecting and Installing the Actuator

Operating the mechanical bladder pump requires holding the outer tube of the concentric tubing set stationary while moving the inner tube up-and-down. Although this maneuver is possible by simply holding the outer tube in one hand and moving the inner tube with the other hand, an actuator makes operation of the pump significantly easier.

NOTE: The tubing set must be completely unrolled for the inner tube to slide freely within the outer tube.

This section identifies the available actuator options. Methods by which the actuators attach to the concentric tubing set and are installed on the monitoring well or tool string are also addressed.

Handheld Manual Actuator

The handheld actuator option is the first step above simply grasping the inner and outer tube by hand. With this option, a Hand Grip Assembly (20545) and Outer Tubing Grip (22758) are installed on the concentric tubing set (Fig. 4.5). Sampling or purging is accomplished by physically holding the outer tubing grip in one hand while raising and lowering the hand grip assembly with the other hand. A handheld actuator may be used to purge or collect samples through probe rods from a groundwater sampler as well as from a permanent monitoring well.

Installation of the handheld actuator is described below.

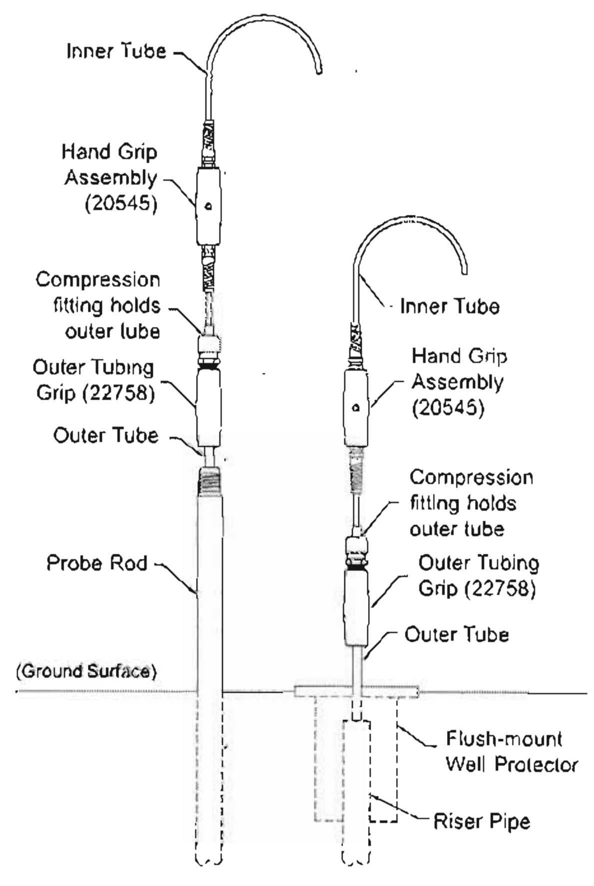


Figure 4.5: Handheld actuator parts for use with groundwater samplers and monitoring wells.

1. Determine the depth to which the pump inlet will be installed as measured from the top probe rod or riser pipe with a weighted tape or water lever meter.

2. The distance from the pump inlet to the top of the tool string or riser pipe (from Step 1) may now be marked on the outer tube. Obtain an assembled MB470 Mechanical Bladder Pump (Section 4.1) with a concentric tubing set installed as instructed in Section 4.2. Beginning from the pump inlet, measure the appropriate distance along the outer tube and mark it with electrical tape or a suitable marker. The tubing set will be installed such that this mark is aligned with the top of the probe rods or riser.

3. Leading with the end opposite the compression fitting, slide the outer tubing grip over the top end of the tubing set. It may be necessary to loosen the fitting slightly (Fig. 4.6) to allow installation.

4. Position the grip with the lower end even with, or slightly above the line marked on the outer tube in Step 2. The specific location of the grip should be determined by operator preference. The important thing is that the pump inlet is maintained at the appropriate level during sampling as indicated by the mark on the outer tube.

5. Secure the grip to the outer tube by tightening the large nut of the compression fitting (Fig. 4.6) until it is "hand tight". Do not overtighten as this may damage the plastic fitting.

6. Carefully cut off the excess outer tube leaving approximately .25 inches (6 mm) above the compression fitting. (Note that the inner tube is not cut at this location). Now measure and cut the inner tube leaving it approximately 3 feet (1 m) longer than the outer tube.

7. Slide the hand grip assembly over the inner tube and position it 1-2 inches (25-51 mm) above the outer tubing grip as shown in Figure 4.6. It may be necessary to first loosen the two compression fittings to allow installation over the inner tube.

8. Secure the hand grip by tightening the two compression fittings. Take care not to overtighten and damage the fittings. Also avoid kinking the inner tube while completing this step

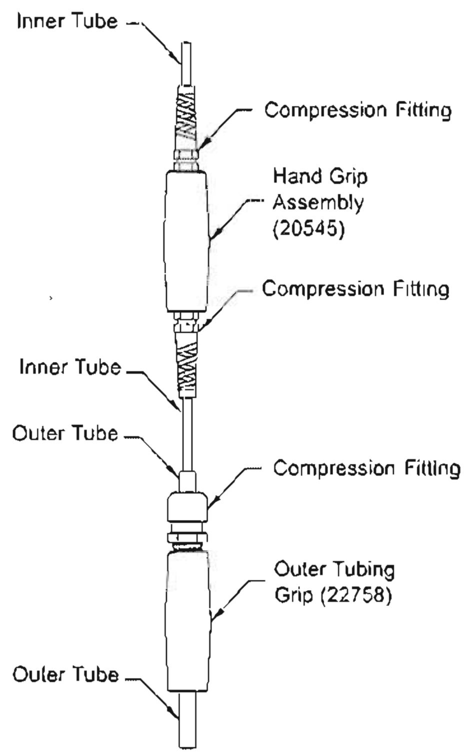


Figure 4.6: Close-up view of hand grip and outer tubing grip.

To operate the mechanical bladder pump with the handheld actuator, simply insert the pump into the probe rod string or monitoring well. Lower the pump and concentric tubing set until the mark on the outer tube (measured and marked previously in Step 2, Page 12) is aligned with the top of the probe rod string or well riser. Initiate pump flow by holding the outer tubing grip stationary with one hand while cycling the hand grip assembly up-and-down with the other hand. A pump stroke of up to approximately 6 inches (150 mm) is recommended.

Anchored Manual Actuator

The anchored actuator option is similar to the handheld actuator in that the mechanical bladder pump is cycled by physically raising and lowering the inner tube using the Hand Grip Assembly (20545). But while the handheld actuator requires a second hand to hold the outer tube, the anchored actuator option utilizes adapters to mechanically secure the outer tubing to the top probe rod or riser pipe as shown in Figure 4.7.

Installation of the mechanical bladder pump with the anchored actuator option is reviewed in this section for both probe rod and well riser applications.

1. The outer tube of the concentric tubing set is connected to the top probe rod or well riser using an Outer Tubing Adapter (20544) plus additional adapters as determined by the size of rod or riser onto which the actuator is to be installed.

   Referring to Table 4.1, select the appropriate adapter(s) for your size of probe rod or well riser. Illustrations and complete descriptions of the various adapters are presented in Table 4.2 and Figures 4.8 - 4.10. Note that .5-inch and 0.75-inch riser pipe each require two PVC adapters in addition to the outer tubing adapter.

2. Assemble the adapters by threading the outer tubing adapter into the probe rod or well riser adapter.

   As illustrated in Figure 4.8, two adapters are required to attach the outer tubing adapter to .5-inch and .75-inch riser pipe. After threading the outer tubing adapter into the 1.0-inch PVC to 1.0-inch NPT Adapter (17558), either a .5-inch PVC adapter (19424) or .75-inch PVC adapter (17559) is then installed in the remaining end of the 1.0-inch PVC adapter.

3. Determine the depth to which the pump inlet will be installed as measured from the top probe rod or riser pipe with a weighted tape or water lever meter.

4. The distance from the pump inlet to the top of the tool string or riser pipe (from Step 3) is now marked on the outer tube:

   Obtain an assembled MB470 Mechanical Bladder Pump (Section 4.1) with a concentric tubing set installed as instructed in Section 4.2. Beginning from the pump inlet, measure the appropriate distance along the outer tube and mark it with electrical tape or a suitable marker. The tubing set will be installed such that this mark is aligned with the top of the probe rods or riser.

5. Slide the assembled adapters (from Step 2) over the top end of the tubing set leading with the end opposite the compression fitting. See Figure 4.7 for adapter orientation. It may be necessary to loosen the compression fitting slightly to allow installation.

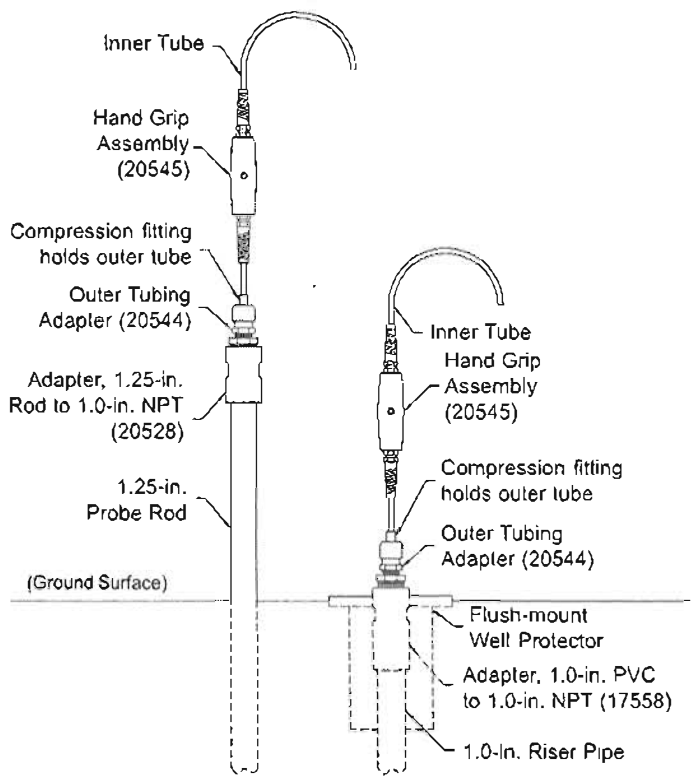


Figure 4.7: Manual actuator parts for use with groundwater samplers and monitoring wells. (Part numbers specified for 1.25-inch probe rods and 1.0-inch riser pipe.)

6. Position the adapters such that the line marked on the outer tube in Step 4 will be even with the top of the probe rod or well riser when the pump is installed on the tool string or riser.

7. Secure the adapters to the outer tube by tightening the large nut of the compression fitting (Fig. 4.7) until it is "hand tight". Do not overtighten as this may damage the plastic fitting.

Size	Probe Rod Adapters	Monitoring Well Riser Adapters
.5-inch	na	17559, 17558, and 20544
.75-inch	na	19424, 17558, and 20544
1.0-inch	20527 and 20544	17558 and 20544
1.25-inch	20528 and 20544	na
1.5-inch	20529 and 20544	na
2.0-inch	na	22759 and 20544

Table 4.1: Part numbers for the adapters required to attach the outer tube to various probe rods and PVC riser pipe.

8. Carefully cut off the excess outer tube leaving approximately .25 inches (6 mm) above the compression fitting. (Note that the inner tube is not cut at this location). Now measure and cut the inner tube leaving it approximately 3 feet (1 m) longer than the outer tube.

9. Slide the hand grip assembly over the inner tube and position it 1-2 inches (25-51 mm) above the outer tubing grip as shown previously in Figure 4.6. It may be necessary to first loosen the two compression fittings to allow installation over the inner tube.

10. Secure the hand grip by tightening the two compression fittings until they are hand tight. Do not overtighten the plastic fittings as damage may result.

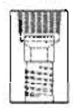
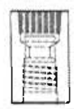
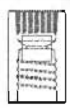
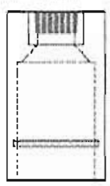
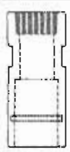
Illustration	Part Number	Description
	20544	Outer Tubing Adapter
	20527	Adapter, 1.0-in. probe rod pin to 1.0-in. NPT pin
	20528	Adapter, 1 25-in. probe rod pin to 1.0-in. NPT pin
	20529	Adapter, 1.5-in. probe rod pin to 1.0-In. NPT pin
	22759	Adapter, 2.0-in. PVC to 1.0-in. NPT Pin
	17558	Adapter, 1.0-in. PVC to 1.0-in. NPT Pin
	19424	Adapter, .75-in. PVC to 17558 Adapter
	17559	Adapter, .5-In. PVC to 17558 Adapter

Table 4.2: Adapters for attaching the outer tube to probe rods and PVC riser pipe.

11. Lower the mechanical bladder pump down the probe rods or well riser. Secure the outer tubing adapter by threading it onto the top probe rod or sliding it over the top of the well riser.

    The mechanical bladder pump is now ready for purging and/or sampling.

Operation of the mechanical bladder pump with a manual actuator is limited to simply raising and lowering the hand grip assembly using a stroke length up to 6 inches (152 mm). This action extends and retracts the pump bladder to push formation fluid to the ground surface through the inner tube of the concentric tubing set. The outer tube is attached to the probe rod string or well riser by adapters and is thus held stationary while the pump is actuated.

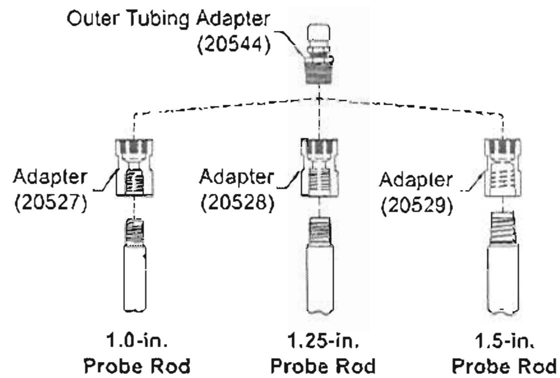


Figure 4.8: Adapters for attaching the outer tube to 1.0-, 1.25-, and 1.5-inch probe rods.

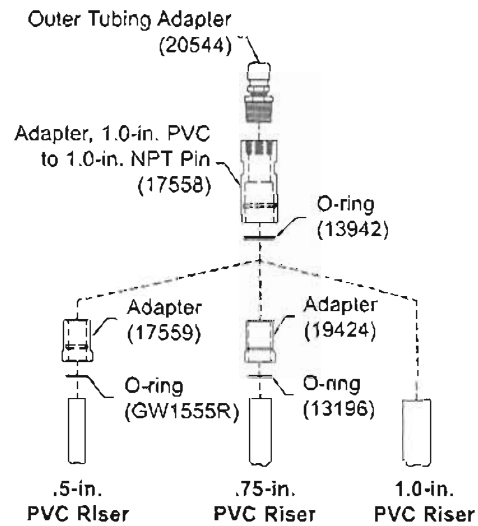


Figure 4.9: Adapters for attaching the outer tube to .5-, .75-, and 1.0-inch PVC riser pipe.

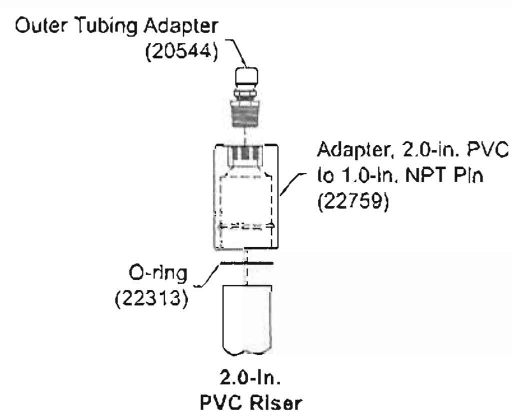


Figure 4.10: Adapters for attaching the outer tube to 2.0-Inch PVC riser pipe.

Mechanical Actuator

The third actuator option for the MB470 Mechanical Bladder Pump is a Mechanical Actuator Assembly (MB6000, Figure 4.10). Rather than physically raising and lowering the inner tube to cycle the pump, the operator simply rotates the handle on the side of mechanical actuator. The actuator assembly converts this rotational action to vertical movement of the inner tube which cycles the pump. The operator may also choose to manually raise and lower the inner tube by disconnecting the side handle and utilizing the T-handle at the top of the assembly.

An advantage of the mechanical actuator option is that it requires little physical input to operate the pump. This translates to minimal operator fatigue when purging or sampling from multiple wells during the day.

The mechanical actuator assembly may be installed directly on a probe rod string (Fig. 4.10) or attached to a flush-mount or aboveground well protector using a Well Mount Kit (MB7200) as shown in Figures 4.11 and 4.12. Installation and operation of the mechanical actuator are described below.

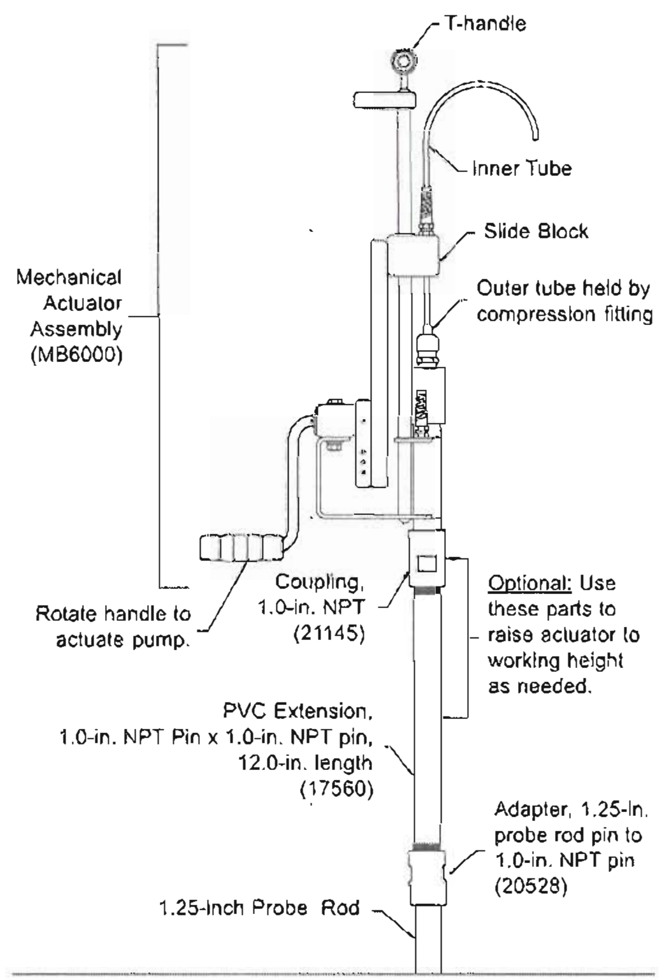


Figure 4.10: Mechanical actuator option for the MB470 Mechanical Bladder Pump (parts shown for attachment to 1.25-Inch probe rods).

1. Determine the depth to which the pump inlet will be installed as measured from the top of the probe rods or well protector with a weighted tape or water level meter.

2. The distance from the pump inlet to the top of the tool string or well protector (from Step 1) may now be marked on the outer tube:

   Obtain an assembled MB470 Mechanical Bladder Pump (Section 4.1) with a concentric tubing set installed as instructed in Section 4.2. Beginning from the pump inlet, measure the appropriate distance along the outer tube and mark it with electrical tape or a suitable marker. The tubing set will be installed such that this mark is aligned with the top of the probe rods or well protector.

3. ***For monitoring wells only:*** Install a Well Mount Kit (MB7200, Figure 3.1) on the well protector. The well mount is strapped onto aboveground well protectors as shown in Figure 4.11 and bolted onto flush-mount well protectors as shown in Figure 4.12. Note that the cross adapter is used for flush-mount protectors that utilize three bolts on the cover (Fig. 4.12) or when the well riser is significantly off center in the protector.

4. Lower the pump and concentric tubing set down the probe rod string or through the well mount into the riser pipe. Stop when the mark on the outer tube (from Step 2) is near the top of the probe rods or well protector.

5. ***For probe rods only:*** Referring to Table 4.2, select the appropriate Probe Rod Pin to 1.0-inch NPT Pin Adapter (20527, 20528, or 20529) to attach the actuator to the top probe rod. Thread this adapter (and a 12-inch extension if additional height is needed) into the actuator as shown on the completed assembly in Figure 4.10.

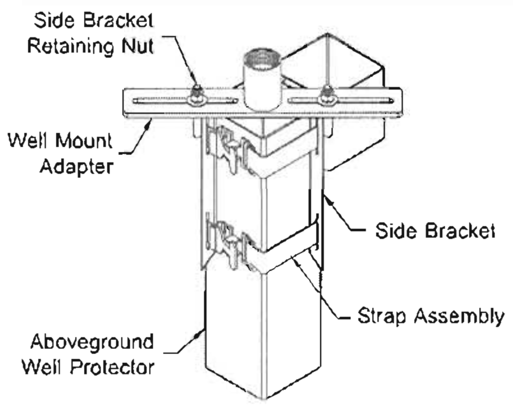
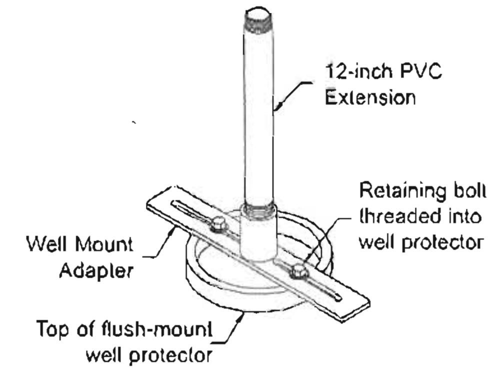


Figure 4.11: Well Mount Kit installed on an aboveground well protector. (Kit may also be used with round protectors.)

Installation for well protectors with two bolts on cover.



Installation for well protectors with three bolts on cover.

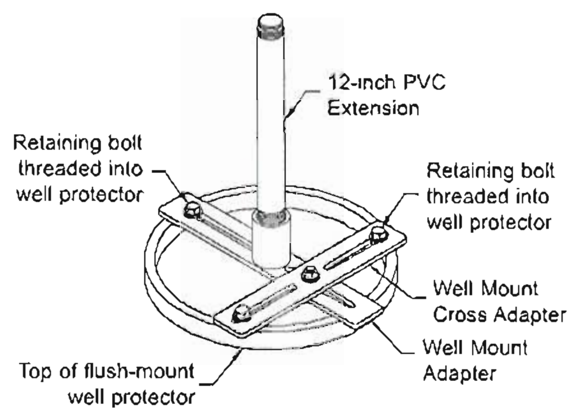


Figure 4.12: Well Mount Kit installed on flush-mount well protectors with 2- and 3-bolt patterns on cover.

6. Insert the top end of the concentric tubing set through the lower end of the mechanical actuator assembly. Feed the tubing set through the actuator and out the compression fitting identified in Figure 4.10.

   For probe rods only: The mark on the outer tube (Step 2) will not be visible once the actuator is installed on the probe rods. To allow for this, position the tubing within the actuator such that the mark will be at the top of the rods when the actuator is installed. Now mark the outer tube at the compression fitting of the actuator assembly for reference later in the installation procedure.

7. Thread the mechanical actuator onto the top probe rod or well mount until all connections are hand tight.

8. Verify the position of the outer tube by observing the mark placed on the tube in Step 2 or 6. Tighten the compression fitting (hand tight) to secure the tubing. Do not overtighten as this may damage the fitting.

9. Carefully cut off the excess outer tube leaving approximately .25 inches (6 mm) above the compression fitting. (Note that the inner tube is not cut at this location).

10. Taking care not to kink the inner tube, insert the inner tube up through the compression fitting on the actuator slide block (see Fig. 4.10 for identification of slide block). It may help to raise the slide block during this step.

    With the slide block fully lowered, gently pull up on the inner tube to remove slack. Do not pull so far that the pump spring is compressed. Tighten the compression fitting to secure the inner tube. Again, do not overtighten as this may damage the plastic fitting.

11. Cut the inner tube leaving it approximately 3 feet (1 m) longer than the outer tube. You may choose to insert the end of the inner tube through the top of the compression fitting on the side of the actuator. This will limit movement of the tube outlet while operating the pump

    The mechanical bladder pump is ready for operation by rotating the side handle of the mechanical actuator or disconnecting the side handle linkage and manually raising and lowering the T-handle.

4.4 Purging and Sampling

The MB470 Mechanical Bladder pump was designed to provide an economical and efficient method to conduct the low flow sampling protocol (Puls and Barcelona 1996, ASTM 2003), Nielsen and Nielsen 2002). The basis of this protocol is that a sampling flow rate of 500 ml/min or less for 2-inch wells (100 to 200 ml/min for smaller diameter direct push wells) generally provides a sample of higher quality that is more representative than sampling at high flow rates (e.g. several liters or gallons per minute). Higher quality samples for volatile organic compounds are obtained because the water being sampled is subjected to less physical and chemical stress so that loss of these analytes does not occur. Additionally, higher quality samples for inorganic analytes (e.g. lead, hexavalent chromium, etc.) are obtained because the low flow sampling method minimizes turbidity that can cause significant bias for these sensitive analytes.

To obtain the most representative samples, the monitoring well or temporary groundwater sampler should be developed before sampling is conducted. Development may consist of simple surging and purging with an inertial pump for temporary samplers depending on the data quality objectives (Geoprobe® 2002). However, more elaborate methods may be required for some monitoring wells (ASTM 2001).

To meet the full requirements of the low flow sampling protocol, field parameters of the pre-sample purge water (temperature, pH, specific conductance, ORP, DO, and turbidity) should be monitored using an in-line flow cell. Once these parameters have stabilized, the samples are then collected in clean, preserved sample containers appropriate for the analytes of concern. Pre-sample purging may be completed in as little as 10 to 20 minutes in adequately developed small-diameter wells with as little as 5 to 10 liters of water generated. In larger diameter wells that have not been adequately developed, a significantly longer purge time and volume may be required.

4.5 Decontaminating the Pump

Decontamination of the pump may be performed in two general ways. For the highest integrity samples the pump should be fully disassembled for thorough decontamination (decon) and the bladder and O-rings replaced. If the pump is being used as a portable pump for sampling multiple locations daily, the pump may be decontaminated while assembled. Review and understand the sampling and data quality objectives for your project before selecting the appropriate decontamination procedure . (For further information on data quality objectives see EPA 1997, or Geoprobe® 2002). The concentric tubing set should be replaced between each sampling location to minimize the potential for cross contamination. If possible, sample from background or low concentration wells to higher concentration wells to minimize the chance for cross contamination.

Disassemble for Decontamination

Simply reverse the procedures described in Section 4.1 to disassemble the pump and concentric tubing set. Place the disassembled pump in a clean beaker or small bucket of water. Use distilled water for highest level of decon. Add Alconox soap (or similar cleaning agent) to the water. Thoroughly clean and brush all inside and outside surfaces. The MBP Cleaning Brush Kit (MB7300) includes four small-diameter brushes selected specifically to clean inside the various pump components. Double rinse all parts with distilled or deionized (DI) water and allow to air dry. Reassemble the pump using a new bladder and O-rings.

Review ASTM Practice D5088 for further guidance and detail on decon procedures. Additional decontamination may be obtained by drying the disassembled pump in a clean drying oven at about 95°C (203°F). This will provide additional assurance that volatile contaminants are removed from pump surfaces.

Decontamination of Assembled Pump

While this method will not provide the assurance of the highest quality samples it may be preferred when lower sample quality is acceptable (For further information on data quality objectives see EPA 1997, or Geoprobe® 2002). When initial site assessments are conducted it is often desirable to obtain many samples at a reasonably modest cost so as to adequately characterize a site. This decon procedure will help reduce the per sample cost while providing acceptable sample quality for many site assessments.

Remove the concentric tubing set from the pump and discard. Submerge the pump in clean soapy water and pump several volumes of water through the pump. Thoroughly wash the exterior of the pump removing all visible dirt or stains. Rinse and transfer the pump to a container of clean tap water or deionized water. Again pump multiple volumes of water through the pump and wash the pump exterior to remove all soap. A second rinse is recommended. Allow the pump to air dry. Again, drying the fully assembled pump in a clean drying oven at about 95°C (203°F) will further remove any volatiles from pump surfaces.

Rinsate Samples

Regularly collect rinsate samples from the pump following decontamination and submit the samples for analysis for the analytes of concern . This will provide another level of quality control and assurance that samples meet the site-specific data quality objectives. Pump clean distilled water through the pump and collect the fluid in an appropriate preserved container. Store, ship and handle rinsate samples in the same manner as field samples.

5.0 REFERENCES

American Society of Testing and Materials (ASTM), 2003. D6771-02 Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations. ASTM, West Conshocken, PA. (www.astm.org)

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American Society of Testing and Materials (ASTM), 1999. D-5088 Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites. ASTM, West Conshocken, PA. (www.astm.org)

U.S. Environmental Protection Agency (EPA), 2003. Environmental Technology Verification Report: Geoprobe Inc., Mechanical Bladder Pump Model MB470. Office of Research and Development, Washington, D.C. EPA/600R-03/086. August.

U.S. Environmental Protection Agency (EPA), 1997. Expedited Site Assessment Tools for Underground Storage Tank Sites: A Guide for Regulators. Office of Solid Waste and Emergency Response. EPA 510-B-97-001. March.

Geoprobe®, 2002. Groundwater Quality and Turbidity vs. Low Flow. Geoprobe Systems®, Salina, KS. May.

Nielsen, David M., and Gillian L. Nielsen, 2002. Technical Guidance on Low-Flow Purging & Sampling and Minimum-Purge Sampling: Second Edition. The Nielsen Environmental Field School, Galena, OH. April.

Parker, Louise V. and Thomas A. Renney. 1998. Sampling Trace-Level Organic Solutes with Polymeric Tubing, Part 2. Dynamic Studies. Groundwater Monitoring & Remediation (GWMR) Vol. XVIII No. 1, pages 148-155. Winter.

Puls, Robert W., and Michael J. Barcelona, 1996. Ground Water Issue: Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures. EPA/540/S-95/504. April.

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems®.

Geoprobe® Systems

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ATTACHMENT B

STANDARD OPERATING PROCEDURE FOR
RESIDENTIAL / WATER SUPPLY WELL SAMPLING

ATTACHMENT B

STANDARD OPERATING PROCEDURE FOR RESIDENTIAL / WATER SUPPLY WELL SAMPLING

1.0 INTRODUCTION

When sampling potable water supply wells it is important to ensure that the samples collected are representative of the aquifer being sampled. Poor or incorrect sampling techniques will result in erroneous sample results that can be disclosed to the public. Incorrect sample results may make any changes in the public perception hard to accomplish when correct results are reported.

2.0 FIELD PROCEDURES

The requirements of a residential or water supply well sampling program should be reviewed with the Project Coordinator prior to initiating sampling activities. While similar field procedures used in groundwater sampling (including documentation, sample identification, date, time, etc.) are required in residential well sampling, additional procedures are also required.

Prior to collection of groundwater samples from a residential or water supply well (referred to as a residential well from hereon in), the well must be purged to ensure that samples collected are representative of the formation. Purging removes standing water from the well casing, pipes, and pressure or holding tank. Purging of a residential well requires the removal of one well volume. If access to the well is not available to determine the well volume, purging for a period of 15 to 30 minutes is generally sufficient. Field measurements for pH, conductivity, and temperature are recorded during purging activities until the readings indicate that stabilization has occurred.

Sampling of residential wells is generally performed using the existing pumping system. However, CRA purging and sampling equipment can be used. It is important that only designated **clean** purging and sampling equipment be used for residential well sampling. The use of the existing pumping system is preferred, as this is more representative of the water quality provided to the residence. Using the existing pumping system also minimizes the possibility of damaging the well and existing pumping system when installing additional purging and sampling equipment.

If CRA equipment is used for residential well sampling, it must be cleaned prior to and between use with a bleach and deionized water solution wash followed by a thorough deionized water rinse.

> *Note: In addition to the special technical procedures noted, CRA personnel must be aware of this unique situation of conducting sampling at private residences. Special care must be taken to be polite and courteous at all times. Offer only necessary information and maintain a clean work area that is returned to pre-sampling conditions. Personnel should have proper identification available, and only remain in areas long enough to complete the required tasks.*

Taps selected for residential well sampling should be located as close to the well as possible. Locate the taps before any treatment systems and, if possible, the pressure tank. It is important to note, if possible, all water treatment devices in operation at the residence including:

- Water softeners
- Filtration units
- Ultraviolet light
- Reverse osmosis
- Distillers
- Chlorinators

Leaking taps that allow water to flow from the stem of the valve handle and around the tap should not be used as sampling locations. Aerators, strainers, and hose attachments should be removed prior to sampling. Maintain a steady flow of water during sampling activities to avoid pressure fluctuations that may cause sheets of microbial growth lodged in the pipes to break loose. Open the cold water tap for a period of 15 to 30 minutes to allow for the complete purging of the pumping system. Maintain a smooth-flaring water stream at a low to moderate pressure without splashing. Do not change the flow rate. Changes in the flow could dislodge particles in the pipes or faucet.

When sampling for microbiological parameters, the end of the faucet must be flame sterilized. During residential well sample, never place caps from sample containers on the ground or in a pocket. Instead, hold the sample container in one hand and the sample container cap in the other. Be very careful not to touch the inside of the sample container cap. Wear new disposable gloves at each sampling location and following contact with a potential contaminant source. The inside of the sample bottle must not be touched with bare hands or allowed to contact the surface of the faucet.

2.1 FIELD NOTES FOR RESIDENTIAL SAMPLING

Full documentation of each residential well is required and includes:

1. Well depth
2. Casing construction and diameter
3. Well installation date if known
4. Pumping system configuration
5. Piping system construction (e.g., copper, lead-joint, ABS)
6. Presence of treatment devices

Obtain the name and exact mailing address for all residence or well owners, as well as home and work telephone numbers. This information is required to inform the residence or well owner of the results of the sampling activities.

Document residential well sampling activities in a standard CRA field book. Note that additional documentation of well details, treatment devices, piping system, and special circumstances are required in the field book in addition to the sample log entry.

ATTACHMENT C

WELL SCHEDULE

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

966158

WELL LOCATION

County: Montgomery Township:

Owner/Builder (Circle One or Both): Miller Valentine (First / Last)

Address of Well Location: 2447 E. River Rd. (Number / Street Name)

City: Moraine Zip Code +4:

Permit No.: Section/Lot No. (Circle One or Both):

Location of Well in State Plane coordinates, if available: Use of Well:

N ☐ X ________ . ____ +/- ____ ft. or m

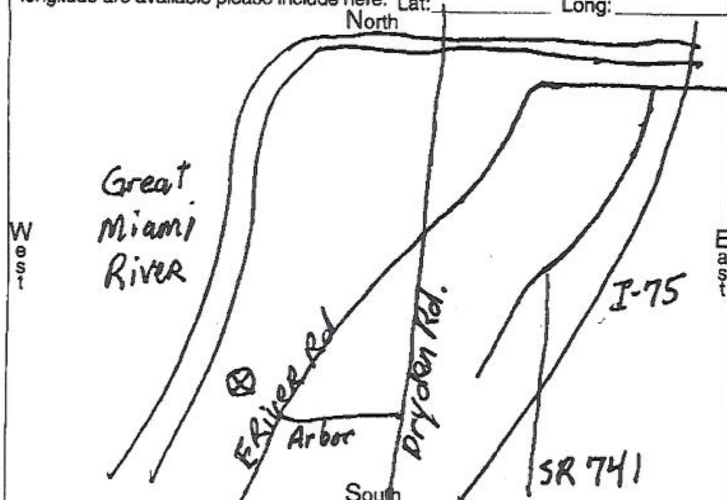
S ☐ Y ________ . ____ +/- ____ ft. or m

Elevation of Well ________ . ____ +/- ____ ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source:

Source of Coordinates: ☐ GPS ☐ Survey ☐ Other

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: ______ Long: ______



WELL TEST*

Pre-Pumping Static Level: 15.6 ft. Date: 2/7/05

Measured from: ☒ Top of Casing ☐ Ground Level ☐ Other

☐ Air ☐ Bailing ☒ Pumping* ☐ Other

Test Rate: 650 gpm Duration of Test: 1 hrs.

Feet of Drawdown: 6 ft. Sustainable Yield: 1000 gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☒ No Flowing Well? ☐ Yes ☐ No

Quality:

PUMP/PITLESS

Type of pump: Submersible Capacity: 700 gpm

Pump set at: 63 ft. Pitless Type: Baker Monitor

Pump installed by: Moody's of Dayton, Inc.

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm: Moody's of Dayton, Inc.

Address: 4359 Infirmary Rd., PO Box 509

City, State, Zip: Miamisburg, OH 45343-0509

Signed: John T. Wagner Date: 3/15/05

ODH Registration Number: 636

CONSTRUCTION DETAILS

☐ Rotary ☒ Cable ☐ Augered ☐ Driven ☐ Other

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter: 12 inches Depth: 98 ft.

Casing Diameter: 12 in. Length: ____ ft. Thickness: ____ in.

2☐ Borehole Diameter: ____ inches Depth: ____ ft.

Casing Diameter: ____ in. Length: ____ ft. Thickness: ____ in.

Casing Height Above Ground: 18" ft.

Type: 1 ☐ 2 ☐ Steel 1 ☐ 2 ☐ Galv. 1 ☐ 2 ☐ PVC 1 ☐ 2 ☐ Other

Joints: 1 ☐ 2 ☐ Threaded 1 ☐ 2 ☐ Welded 1 ☐ 2 ☐ Solvent 1 ☐ 2 ☐ Other

SCREEN

Diameter: 12" Slot Size: .060 Screen Length: 30 ft.

Type: Wire wound Material: 304

Set Between: 68 ft. and 98 ft.

GRAVEL PACK (Filter Pack)

Material/Size: ~~Bentonite~~ ~~Volume/Weight Used: 50 lbs~~

Method of Installation: ~~Dry grout~~

Depth: Placed FROM ____ ft. TO ____ ft.

GROUT

Material: Bentonite Volume/Weight Used: 50 lb

Method of Installation: Dry grout

Depth: Placed FROM ____ ft. TO ____ ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.

Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
Clay, fly ash	0	7
Sand, gravel, cobbles	7	32
Grey clay, sand, gravel	32	33
Large gravels, sand	33	98

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion: 2/28/05 Total Depth of Well: 98 ft.

Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ. DRIVE, COLS., OHIO 43224-9971

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

Water Well Log and Drilling Report

Ohio Department of Natural Resources
Division of Water
Phone: 614-265-6740 Fax: 614-265-6767

Well Log Number: 966158

View Image of Original Well Log

ORIGINAL OWNER AND LOCATION

Original Owner Name: *MILLER VALENTINE*

County: *MONTGOMERY* **Township:** *MORAIN* **Section Number:**

Address: *2447 RIVER RD E* **Lot Number:**

City: *MORAINE* **State:** *OH* **Zip Code:**

Location Number: **Location Map Year:** **Location Area:**

Latitude: *39.720290* **Longitude:** *-84.22334*

CONSTRUCTION DETAILS

Borehole Diameter: 1: *12 in.* **2:** **Borehole Depth: 1:** *98 ft.* **2:** **Depth to Bedrock:**

Casing Diameter: 1: *12 in.* **2:** **Casing Length: 1:** **2:** **Casing Thickness: 1:** **2:**

Casing Height Above Ground: *1* **Aquifer Type:**

Date of Completion: *2/28/2005* **Total Depth:** *98 ft.* **Well Use:**

Driller's Name: *MOODY'S OF DAYTON, INC.*

Screen Diameter: **Slot Size:** *0.06 in.* **Screen Length:** *30 ft.*

Type: **Material:**

Set Between: *From: 68 ft. To: 98 ft.*

Gravel Pack Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed:**

Grout Material/Size: **Vol/Wt Used:**

Method of Installation: **Placed**

WELL TEST DETAILS

Static Water Level: *15 ft.* **Test Rate:** *650 gpm* **Associated Reports**

Drawdown: *6 ft.* **Test Duration:** *1 hrs.* *NONE*

COMMENTS: *NONE*

WELL LOG

Formations	From	To
CLAY	0	7
SAND & GRAVEL	7	32
GRAY CLAY/SAND/GRAVEL	32	33
LARGE SAND & GRAVEL	33	98

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Print This Page Return to County Search

Well log questions - Web site questions - Web policies